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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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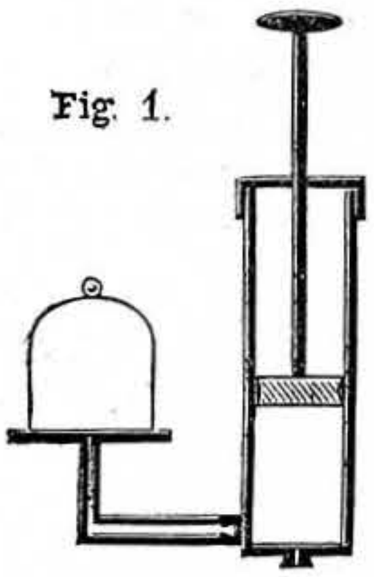
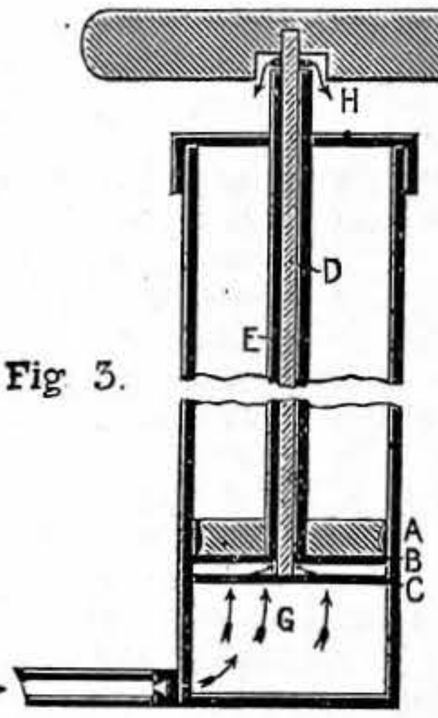
Fig. 1.





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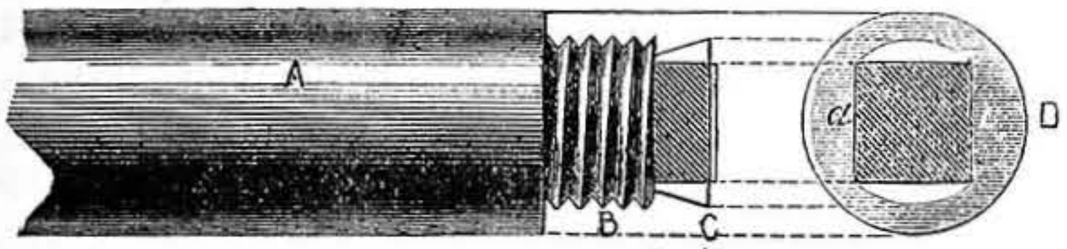

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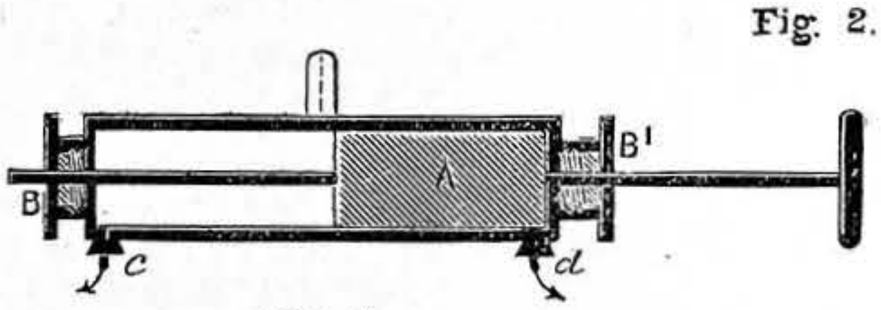

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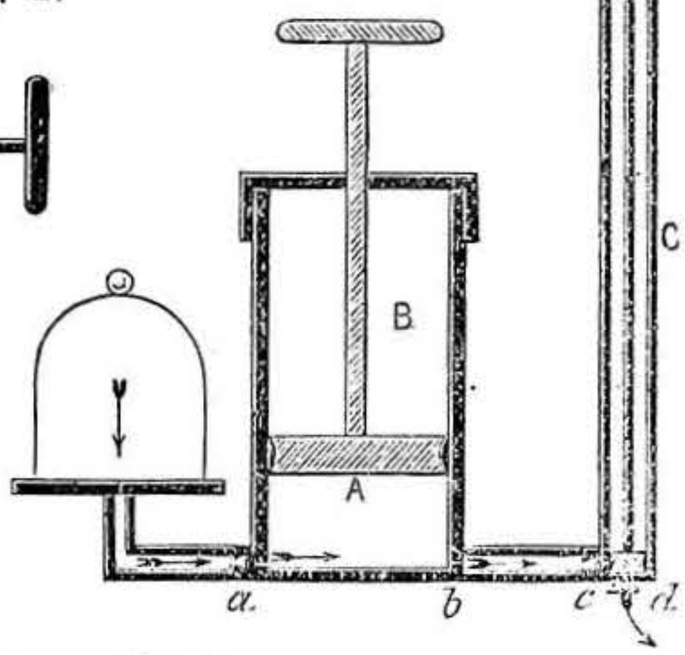

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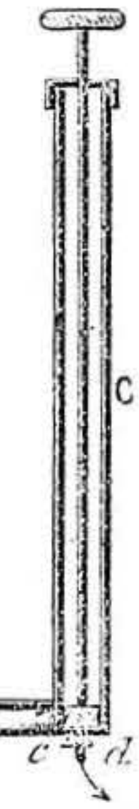

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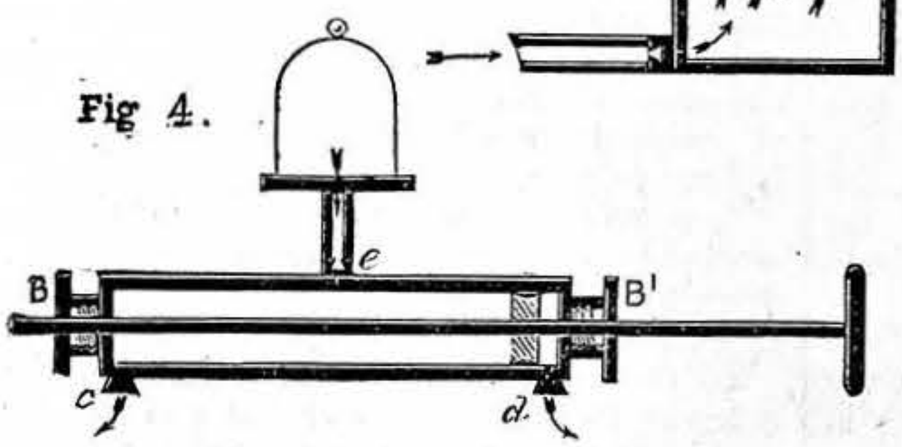
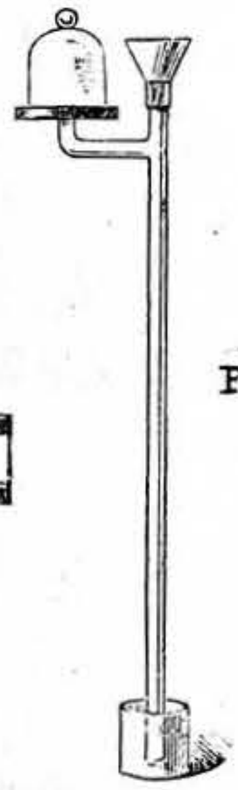




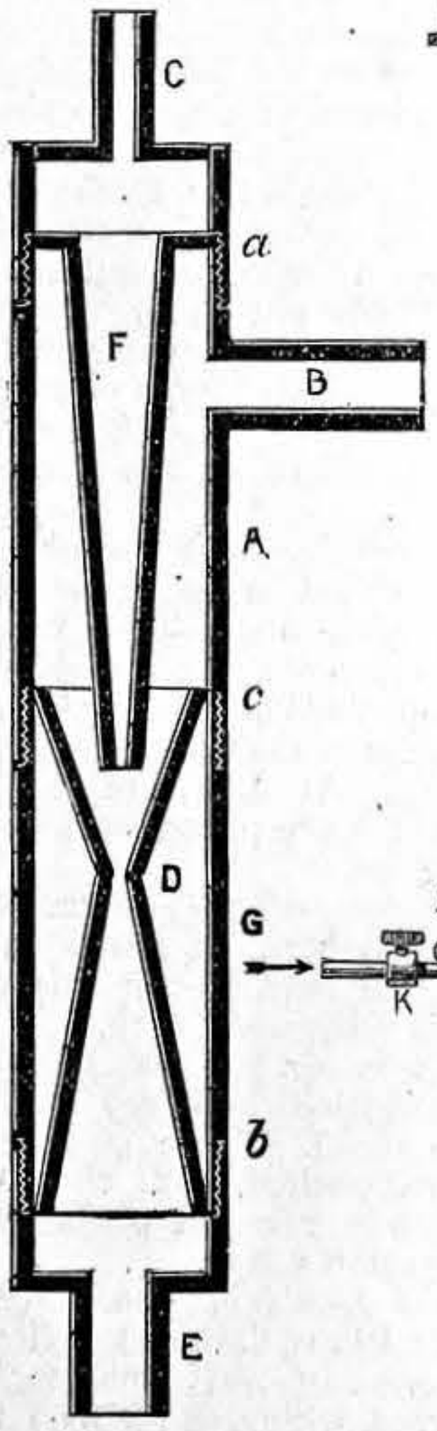


Fig. 7.

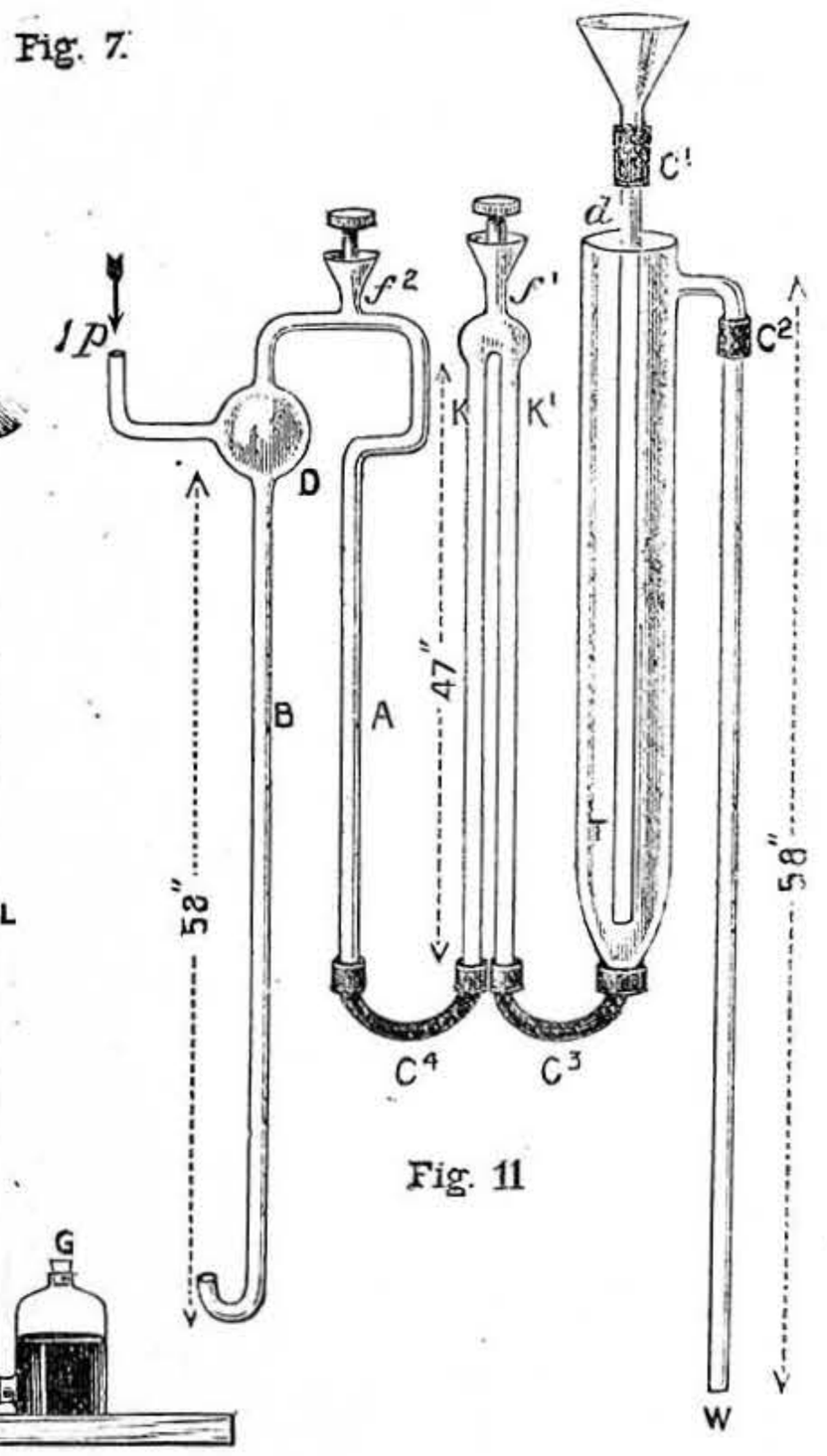


Fig. 11

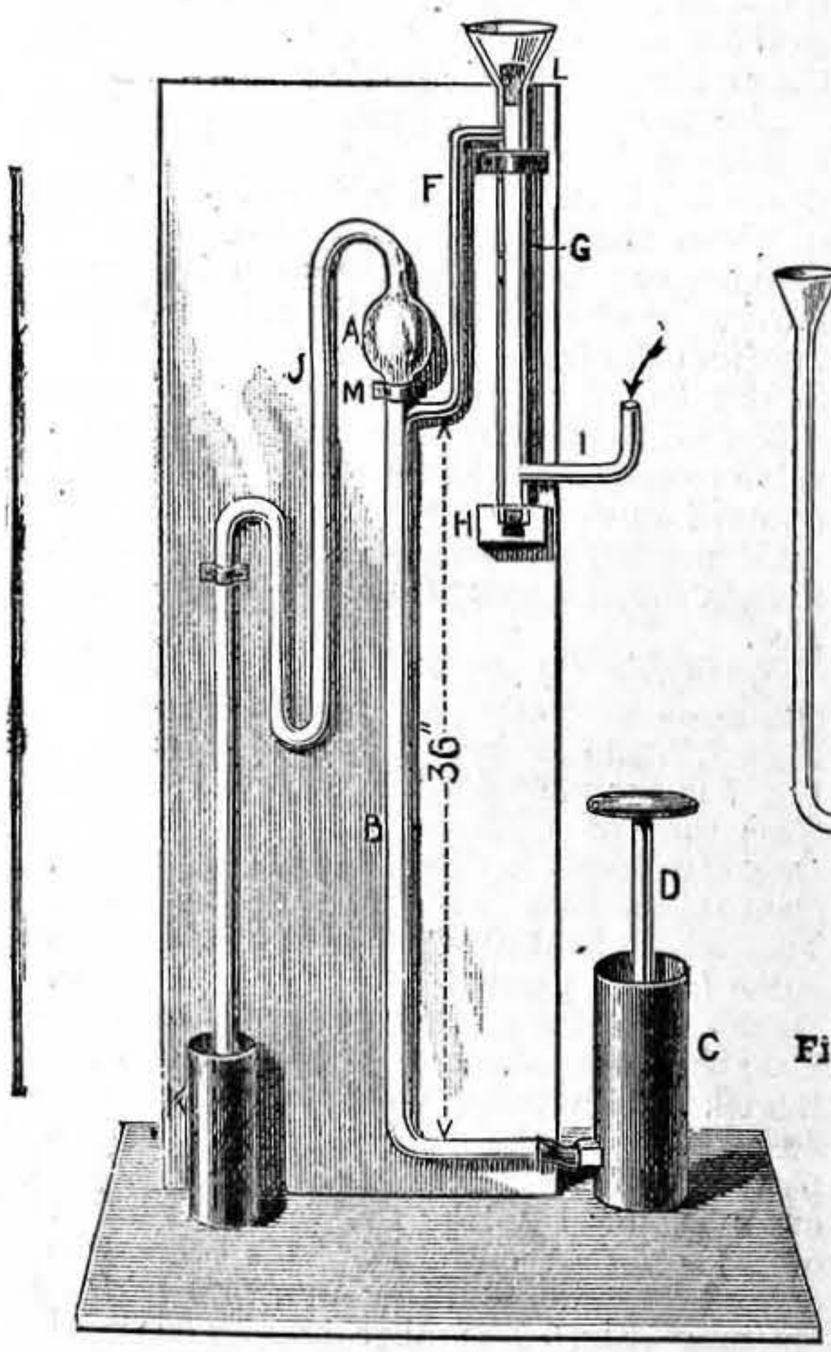
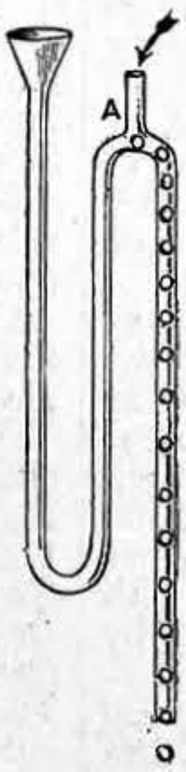


Fig. 10.



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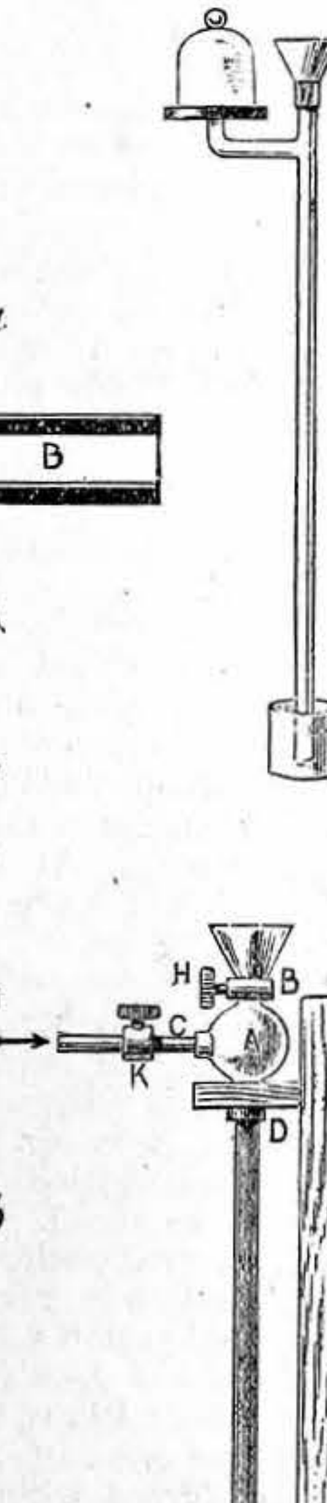

Fig. 8.

Fig. 12.

Fig. 1.—Common Air Pump. Fig. 2.—Valve (full size). Fig. 3.—Mechanical Valve in Barrel. Fig. 4.—Double-action Air Pump. Fig. 5.—Double-action Solid Piston. Fig. 6.—Double Exhaust Pump. Fig. 7.—Springle's Mercury Pump. Fig. 8.—Geissler's Mercury Pump. Fig. 9.—Springle's Pump. Fig. 10.—Sutton's Mercury Pump. Fig. 11.—Springle's Pump. Fig. 12.—Modification in Brass of Mawson and Swan's Operator.

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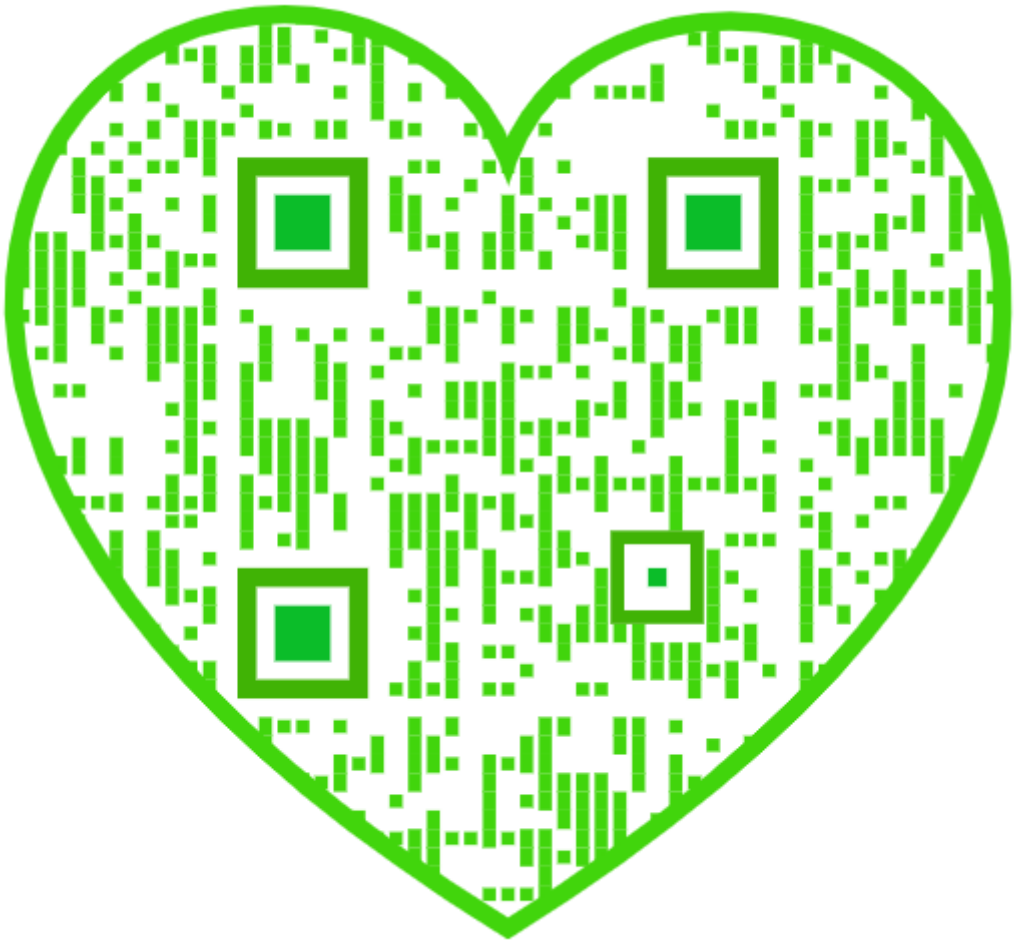

AIR PUMPS AND THEIR CONSTRUCTION.

BY O. B.

INTRODUCTION—VACUUMS UNKNOWN—KINDS OF AIR PUMP—PISTON AND BARREL PUMPS—JOINTS—VALVES—PISTONS—IMPROVED PISTON—DOUBLE STROKE—SOLID PISTON—IMPROVED DOUBLE PISTON—MERCURY PUMP—SPRINGLE'S PUMP—PERFECT PATTERN—GEISSLER'S PUMP—SUTTON'S PUMP—WATER ASPIRATORS—MAWSON AND SWAN'S MODIFICATION IN BRASS.

Introduction.—The advances which have been made in late years in electric lighting and other departments of physical experiment and investigation have rendered air pumps of the highest efficiency an absolute necessity. It is the purpose of the writer to offer such observations as will help the amateur to succeed in his various operations.

Vacuums Unknown.—It may be taken for granted that to produce an absolute vacuum is an impossibility as far as our efforts are concerned, for if even all air and vapour of water could be extracted from a containing vessel, it is highly probable that vapours would be thrown off from the material of which the vessel was made.

Still, though an absolute vacuum may be impossible, yet air, etc., may be reduced to such tenuity as to prevent the passage of electricity; for it is a misconception to suppose that a perfect vacuum is needed in an electrical vacuum tube; a certain quantity of attenuated matter is necessary to render the energy visible.

Kinds of Air Pump.—Air pumps may be broadly divided into two classes: First, those in which a cylinder and piston are used; and secondly, those in which the falling of a fluid is made to entangle portions of air.

Piston and Barrel Pumps.—Of these there are various kinds: such as the single-action barrel (Fig. 1). This, if carefully made, is fairly efficient.

Joints.—The three points to pay especial attention to are: first, joints. To make good joints with solder may seem very simple, but where air pumps are concerned it is really not so. I have known days spent by professional workmen—and they, too, makers of scientific instruments—in the endeavour to find a leak, and, after all, were baffled. The plan the writer has adopted is to place the parts under water and force air into them. A leak is shown by a bubble. Another point to attend to is to boil the work in water in which soda has been dissolved. If any kind of soldering fluid is employed, and a portion is left in any crack or crevice, it will be sure to corrode, and eventually make a leak probable.

Valves.—Secondly, valves. The holes should not be larger than will admit a dress pin; indeed, it may be said the smaller they are the better. On the edge there must be no burr or sharpness that can, by possibility, cut the silk. A general idea of a valve is given in Fig. 2. The tube, A, is turned down, and a screw thread is chased on it at B. A disc, C, $\frac{1}{4}$ in. thick, is carefully soldered on the end; this is under-cut as shown. In the centre a fine hole is drilled. The end of the disc must be made perfectly true, without the suspicion of hollowness; too much attention cannot be paid to this, as if the silk does not lie perfectly close to the disc it cannot be air-tight. Two sides of the disc must now be cut away, as shown at D. The edges must be carefully smoothed and a strip of oiled silk, *a c*, must be drawn over the end and carefully tied, as shown. Due attention must be paid to the quality of the silk; in fact, no portion of the work must be performed carelessly, for in vacuum apparatus most certainly the strength of the instrument is only equal to its weakest point.

The action will be easily seen when a vacuum is made in the barrel; the air in the receiver expands and passes under the silk. As soon as the piston returns and the pressure is greater than in the receiver, the silk is forced on the disc, and the return of air is prevented.

Pistons.—Thirdly, the piston. This, as made and applied in the ordinary pump, is very inefficient, as when the air in the vessel is reduced to a given rarity and flows into the barrel, it cannot be compressed sufficiently to overcome the pressure of the outside atmosphere, and so cannot force open the outer valve.

Improved Piston.—But there is another method which may be adopted, and the wonder is that it is not always used, as the valve is mechanical, and independent of the pressure of the atmosphere.

Fig. 3 is a sectional diagram. The under side of the piston, A, is faced with a disc of rubber, B. The rod attached to this is a hollow tube, E; C is a disc of brass in which are drilled four or five holes, as at G. To this disc is securely fastened the rod, D, small enough to work in the tube carrying the piston. This rod is fastened to the cross-handle, and is $\frac{1}{8}$ in. longer than the tube in which it works.

We will suppose the piston is at its lowest point. In pressing it down the disc has been forced away from the piston, and the air in the barrel has escaped through the pin-holes and by the hollow piston-rod. As soon as the handle is drawn up, the disc beds on the rubber sole of the piston and connection with the outer atmosphere is cut off. In the vacuum thus formed the air rushes in from the vessel, and the action is repeated. This is a very great improvement over the ordinary method, in which there is always a residuum of vapour which cannot be compressed sufficiently to overcome the pressure of the external atmosphere.

Double Stroke.—The barrel and piston may be modified in various ways: such as a double stroke, in which the valve leading from the receiver is placed midway between the extreme ends of the barrel (Fig. 4), by which means exhaustion is produced at each stroke. At B, B′, are stuffing-boxes, through which the piston works. At *e*, *c*, *d*, are silk valves.

Solid Piston.—Fig. 5 is a modification of this plan, only here is a piston one-half the length of the barrel. By this means the valve, *e*, is dispensed with. In all other respects it is similar to Fig. 4, though perhaps it is needless to say that its action is not so rapid. There is also a further well-known method, viz., the pump with two vertical barrels and pistons worked by rack and pinion action.

Improved Double Piston.—Fig. 6 is an instrument I have designed, being a modification of one designed some years since by a Mr. Turton, which, as far as I am aware, has never been taken up in a commercial way, or received the attention it has deserved. We have seen already that the one great drawback in the ordinary pump is that the residual portion of air becomes so rarefied ultimately that it cannot be compressed sufficiently to overcome the pressure of the outer atmosphere. When this condition is obtained no further exhaustion can take place

By the arrangement here shown this difficulty is minimised to a large extent. The barrel, B, is in communication with the receiver, and the small barrel, C, communicates with B. At *a* and *c* are valves which open into the respective barrels, and at *d* one for the expulsion of the air. The action is as follows: Let the piston of C be raised to its full height. The piston of B is now to be used until the receiver is so far exhausted that the rarefied air can no longer open the outer valve, *d*. The piston, *c*, is now forced down; but as the barrel is so much smaller than B, the residual air can be correspondingly compressed, and a portion forced out. When raised, there will be a comparative vacuum left, into which some of the residual air can be pumped until the atmosphere in C becomes so dense that the air from the large barrel can no longer force open the valve, *c*. The piston in C is now forced down, and compresses the atmosphere so much that it is equal to overcoming the resistance at valve *d*, and is again raised, forming a vacuum. This process goes on, working the alternate barrels until the atmosphere becomes so rarefied that no further exhaustion can take place, which will be much more complete than by the ordinary method. In the construction of a pump on this plan, the one point to be remembered is that the smaller the area of C is as compared with B, the better, whilst an obvious advantage will be gained by making C as long as possible. The longer it is the more air it contains; the smaller in the bore it is the smaller will be the amount of residual air left in it when the piston is forced down.

A convenient, and at the same time a workable, size would be large barrel, 2 in. diameter by 6 in. high; the smaller, $\frac{1}{2}$ in. by 12 in. high.

By this means, when B has exhausted the receiver to a point where the residual air could no longer overcome the outer valve, it can be further compressed sixteen times, as the area of C is only $\frac{1}{16}$ that of B, and thus the rarefaction can be further carried on.

Mercury Pump.—Besides the various modifications of the barrel and piston described, there is another class of apparatus in which the piston is a stream, either of mercury or water. As the piston is always moving in one direction, the difficulty arising from the incompressible residuum found in the barrel of the best model we have described is done away with. There is no valve to open, and the vacuum can be carried on until an electric spark will not pass.

Of mercury pumps there are various types, though they all start from the same central idea.

Springle's Pump—Simple Pattern.—The one most generally known is the Springle. Figs. 7, 9, and 11 are various modifications. Fig. 7 is the most simple. It consists of a glass tube of small bore, and 40 in. long. One end opens into a funnel; about 2 in. from this, a tube is placed at right angles. This is also bent at right angles, so that its outer end is parallel with the main tube. To the short tube is attached the vessel to be exhausted. Mercury is poured into the funnel, which must be kept full. As it flows it forces the air before it, causing a partial vacuum. The air in the vessel expands, and entering the tube, a portion of it is forced onwards. This process is carried onwards, resulting in a very perfect vacuum. Fig. 9 is another form. The vessel to be exhausted is attached to the stem A.

Perfect Pattern.—In Fig. 11 we have the same instrument expanded to its perfect

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form, which yields the most perfect results attainable.

The tube, T, should be about 50 in. long, ¾ in. bore; A is about the same length, and ⅘ in. bore. Tubes K, K¹, are 47 in. long and ⅘ in. bore. At the bend they are expanded somewhat: with a funnel fused as shown. D is a globe, such as can be procured at most chemical and laboratory stores, having three openings. A tube of fine bore, $\frac{1}{15}$ in., is bent as shown, into which is fused the funnel, f^2; p is a short length of tubing bent to right angles, and fused into the globe; B is the same bore, and 58 in. long. In the two funnels, f^1 and f^2, glass stoppers are ground, or else corks which have been thoroughly soaked in paraffin-wax must be used. The tubes A and K are connected by strong indiarubber tubing. For this purpose bicycle cement should be used. Strong tape, with one side dressed with the cement, must be wound round the tubing: this will give the necessary resistance to the pressure of the mercury. K¹ and T must be joined in the same manner. The waste-pipe, W, must be joined by a short length of rubber; also the funnel, C¹, to the tube, *d*. The vessel to be exhausted is attached to the tube, *p*. Under B must be placed a vessel to receive the mercury as it flows. To use the apparatus, proceed thus: Strong spring clips are placed at c^2, c^3, and c^4. Pour mercury into the funnel C until T is nearly full. Remove the stopper, f^1, also the clip, c^3, and pour in mercury until f^1 is nearly full, when replace the stopper with the mercury flowing round it, thus sealing it. Further sealing may be effected by pouring water on the top of the mercury. Clip c^4 is now removed, when the mercury will rise in A, leaving a vacuum in the bulb at K K′, where will accumulate any air which may be contained in the mercury.

As more mercury is poured in the funnel, C, the funnel, f^2, will fill, driving all air before it, when it must be sealed as the other. The mercury will now fall through the bulb, D, into the tube, B, in the form of drops. So much air having been removed from the bulb, the air in the vessel expands, and again fills the bulb. The next fall of mercury forces another portion out. For a while the portion of air between each succeeding drop will form a cushion; but when the exhaustion is complete, the mercury will fall with a distinct click or knock, showing that there is no film of air between the separate drops, and that its work is complete; exhaustion can thus be carried on until the air in the vessel to be exhausted is only $\frac{1}{1000000000}$ of its original quantity.

Geissler's.—This (Fig. 8), for complexity, stands midway between the extremes already described, whilst for efficiency it is all that can be desired. D is a shelf for holding a bulb, A, with three openings. At B is a funnel with a ground glass tap. At C is a tube with a similar appliance. At D is attached a strong rubber tube in the manner already described. The lower end of the tube is joined to a jar containing mercury. To work the instrument, fasten the vessel to be exhausted to the tube, C, and close the tap, K. Open the tap, H, and raise the bottle, G, until the mercury fills the bulb as well as the funnel. Now close the tap and replace the bottle on the stand; the mercury will fall in the tube, leaving a vacuum in the bulb. Open the tap, K, when the air will rush in from the vessel and fill the bulb. Now close K and open H, and fill the bulb with mercury as at the first, and again exhaust it by lowering the bottle. Each time this is done a portion of air is removed, until at last, when, with both taps closed and the bottle raised, the bulb fills with mercury, we know the exhaustion is complete.

Sutton's.—Fig. 10 is an instrument which bears the name of Sutton, which is somewhat less complicated than Fig. 11, and at the same time all that can be desired in the way of efficiency. The illustration will almost explain itself. B is a glass tube which develops into a bulb. It should measure not less than 36 in. from the lower bend to the point where the tube, F, joins it. G is a tube of about ¾ in. bore, terminating with a funnel, L. Into this are fused the tubes, F and I. The tube, G, is filled with small lumps of pumice-stone or fibres of asbestos which have been dipped in sulphuric acid. This is for the purpose of absorbing any moisture. Each end of the tube is to be secured by a stopper, either of ground glass, or cork prepared as already described. The funnel is now filled with mercury; a glass vessel is placed so as to contain the lower end of the tube. This, too, contains mercury; by these means the tube is securely sealed. C is an iron vessel with its inside accurately bored and fitted with an iron piston. A strong tube of rubber connects the cylinder to the tube, B. At K a vessel is placed to receive the overflow mercury. To use the instrument, proceed as follows: attach the vessel to be exhausted to the tube, I. Force the piston down until the mercury rises in the bulb and fills the tube, J. Now raise the piston to its original position, when the mercury will fall out of the bulb, leaving the bulb vacuous, the mercury at the same time rising in the bent tube, J, until it balances itself to the atmospheric pressure. The mercury must be allowed to fall in the tube so as to be just below the point where F joins it. When this point is reached the air rushes in from the vessel to be exhausted, filling the bulb, at the same time causing the mercury to sink in the bent tube, J. It may be observed that the bending of this tube forms a trap, as, though air can be forced down, it cannot of its own accord rise up the tube and pass the mercury, seeing its gravity is so much less than the metal. When the inrush by the tube, I, has been made, the piston is again pressed down; the mercury rising above M at once seals the communication with the vessel to be exhausted, and, filling the bulb, expels the air by the tube, J. This is to be continued until the vessel is exhausted, which will be manifest when the mercury forced over ceases to be separated from the preceding portion by a cushion of air, and the column is continuous.

For the tube, B, a bore of ⅛ in. will be sufficiently large, whilst for the tubes, J and F, the ordinary barometer tube should be used. By the use of these appliances gases can be so rarefied in vacuum tubes that the electric spark fails to pass, for want of a medium dense enough to conduct it.

Water Aspirators.—This article could hardly be considered complete if no reference was made to apparatus in which water is used in the place of mercury. The principle of construction is similar to those given. Whilst they are very useful in the laboratory for many purposes where a high vacuum is not required, yet for some purposes they are useless.

Mawson and Swan's.—Messrs. Mawson and Swan, well-known makers, have introduced, however, a pattern which is very effective. It is exceedingly simple in construction, and, consequently, inexpensive. As its price is only 4s., it would hardly pay anyone to attempt to make one, unless it were for the love of making, which is an instinct with all true amateurs.

Modification in Brass.—As sold by the firm mentioned, it is made in glass, though it might easily be made in brass; the extra cost and labour would be balanced by its greater strength and non-liability to be broken.

The diagram (Fig. 12) will give a correct idea of its construction. A is a tube of brass into which is soldered the tube, B, which is to be attached to the water-main. C is another tube to which the article to be exhausted is attached. At the juncture of these tubes, *a*, a perforated disc is soldered, to which is joined a fine bore taper tube, F, as shown. D is a tube composed of two cones joined at their apex and soldered to tube G. E is a tube to which is attached the waste-pipe, and is joined to G at *b*. G and A are joined at *c*. This will quickly produce a vacuum capable of sustaining a column of mercury of nearly the full barometric height. As sold by Messrs. Mawson and Swan, the instrument is much more simple than it appears in brass, and quite as efficient; but the hints I have given are for those who prefer to make their own instrument, but are unable to work in glass.

All the screwed joints in the above instruments must be made air-tight with white lead.

STAGE PERSPECTIVE.

BY WILLIAM CORBOULD.

INTERIORS: THEIR PERSPECTIVE, AND HOW TO OUTLINE THEM.

WE will take a square room first, drawn in parallel perspective, supposing the spectator to be standing in front and looking into the centre of the room. (See Fig. 7.) The vanishing or points of measurement in this case, on the imaginary horizontal line, B B, are *a*, *a*. The point of sight, *c*, would be the vanishing point where all lines must fall into. The line *d d* is the base or commencement of the floor; a line drawn from each corner at *b*, *b*, to the vanishing point, *c*, would give the base of each side of the room, *f*, *f*; by the same rule, lines drawn from the top corners, *e*, *e*, to the point, *c*, will give the top of the sides, or the ceiling lines. Draw lines from the corners, *b*, *b*, to the points of measurement, *h*, *h*. Where these lines cross, base lines, *f*, *f*, would come, the two upright lines forming the further sides of the room. The top and bottom lines, *g*, *g*, complete that side, or the back wall of the room. Point A is the spot where the spectator stands.

The reader of these rules will observe that the points of measurement, *a*, *a*, in all the drawings extend beyond the square lines of the rules laid down. This brings the scene well within the circle of 60°. It will be seen also that you get greater breadth and boldness, as the top and bottom lines will not drop or rise too suddenly. When the points, *a*, *a*, are brought in closer to your work, you would see the difference. It would dwarf your work. On the other hand, the further you keep the points of measurement, the opposite is gained—*viz.*, breadth and boldness. Supposing you were painting a scene which took up all the space of the room or stage you were painting on, and you could not get your measurement point on the horizontal line beyond the square of your scene: place a dot a little above and one a little below the horizontal line. (See *h*, *h*, Fig. 7.) You will

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see that all lines passing through those dots would fall into the points, *a*, *a*. It will be seen at once that the further apart the dots, *h*, *h*, are the broader and higher would be the room.

Fig. 8 shows an interior drawn in oblique or angular perspective. It will be seen by this rule that the base or floor lines are drawn—one from the right corner, *b*, to the vanishing point, *a*, on the left of the horizontal line; the other from the left corner, *b*, to the vanishing point, *c*, which is the point of sight. You will see this point of sight is shifted from the centre a little to the right. By doing this, you raise the height of the wall in the corner of the room, giving greater breadth and height to the walls of the room. By the same rule, if you shift the dot, *c*, to the left, you will get greater length, which you may want to do at times. Lines drawn from each corner, *e*, *e*, to the same points, *a* and *c*, will give the ceiling lines. When a cornice is shown, those lines would start inside, according to the width of the cornice, as at *d*, *d*. All lines on the right side of the room would fall into the left-hand point, *a*, while all lines on the left side of the room would fall into vanishing point, *c*. Bear in mind, these lines are such as dado, mantelpiece, doors, windows, pictures hanging on the walls, etc. A little practice and judgment will soon make it easy.

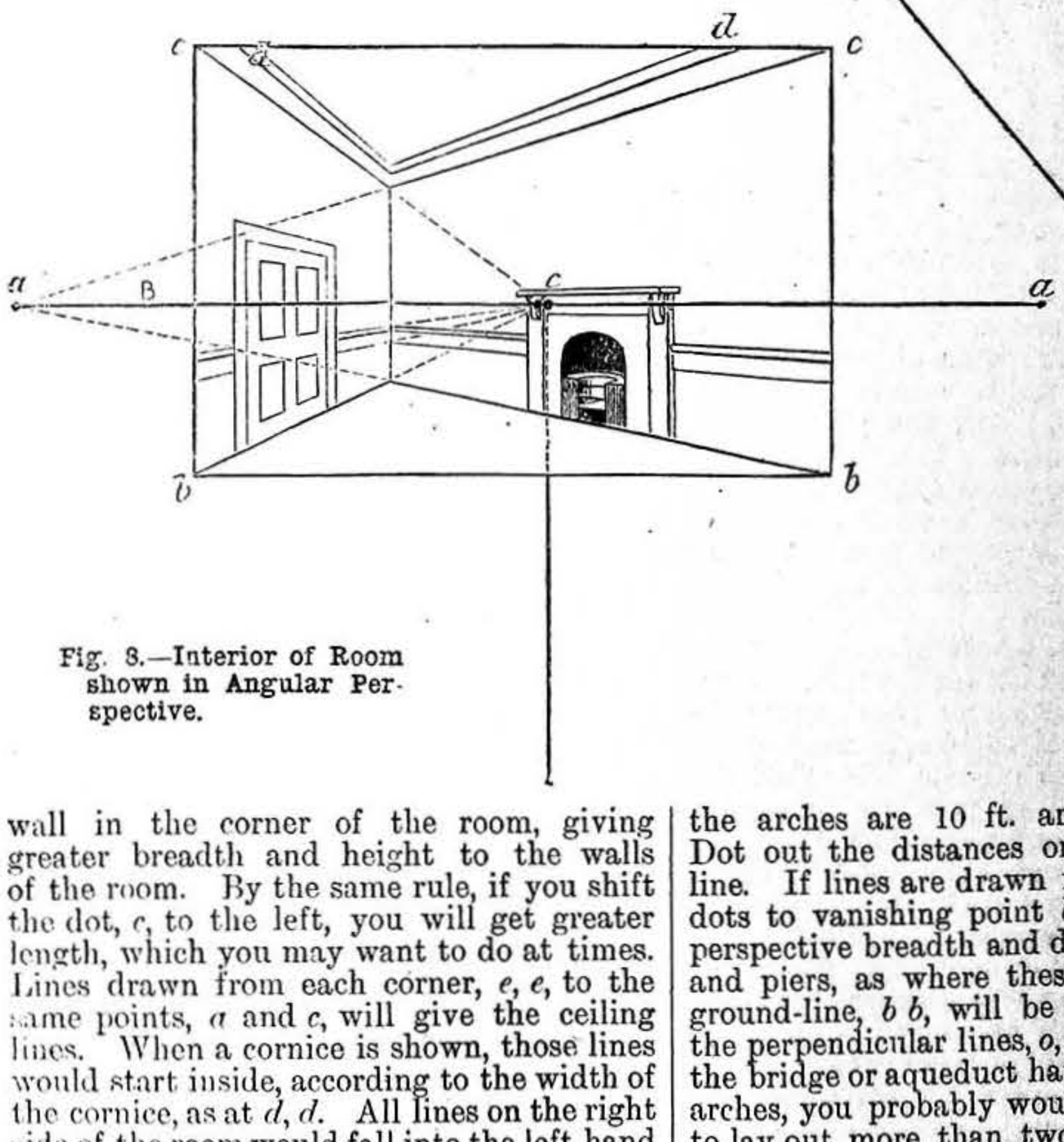

Fig. 8.—Interior of Room shown in Angular Perspective.

Fig. 9 is also in oblique or angular perspective, and shows the way to draw a bridge or aqueduct. Just draw your horizontal line, B B; then the point of station, A, fixing this a little to the left of the centre. It will be seen that the line drawn from A to *a* on the horizontal line is longer than the line drawn from point, A, to measuring point, *b*. I have mentioned this again to show the difference between parallel and angular perspective, as these lines may all be imagined. When the artist has mastered the rule, having decided upon where your bridge shall start from, you erect your first upright line, *c c*; divide this line in half, as at *e*; draw a line from *e* to measuring point, *a*. You will find the use of this line further on. Now draw your geometrical scale, *d d*, from the bottom of your first perpendicular line. You lay out the breadths of the several arches and spaces between them on this line. Say the arches are 10 ft. and the piers 3 ft. Dot out the distances on the geometrical line. If lines are drawn from these several dots to vanishing point *b*, it will give the perspective breadth and depth of the arches and piers, as where these lines cross the ground-line, *b b*, will be the spot to erect the perpendicular lines, *o*, *o*, *o*, *o*, *o*. Should the bridge or aqueduct have more than two arches, you probably would not have room to lay out more than two on your geometrical line; therefore, you must adopt another simple plan. This is where the line from dot *e* to point *a* comes in useful. It will be seen that the lines marked *h* when drawn the first one from *c* to *c*, cut line *e* exactly where the second perpendicular line rises from the ground-line, *b*; given the perspective width of the first arch, as laid out on the geometrical scale, the next line from *o* to *b* gives the second arch; the two lines in front of the two first, which we have just drawn, gives the width of the piers. You will now see that after the first two arches are drawn how easy it is to get the rest, by continuing the diagonal lines through each pair of arches where it intersects the centre line, *e*, with each and every perpendicular line, drawn from where the previous diagonal line comes in contact with the ground-line, *b b*; a line drawn from dot *g* to measuring point, *a*, would give the apex of each arch. I might show other lines, such as those indicating the parapet and ornamental parts of the bridge, but this is not requisite, because if the pupil will study the rules of perspective which I have laid down as simplified as possible, he will soon overcome any difficulty he may have to contend with at first, and he must always remember and bear in mind that perspective is the grammar of art.

Fig. 7.—Square Room in Parallel Perspective.

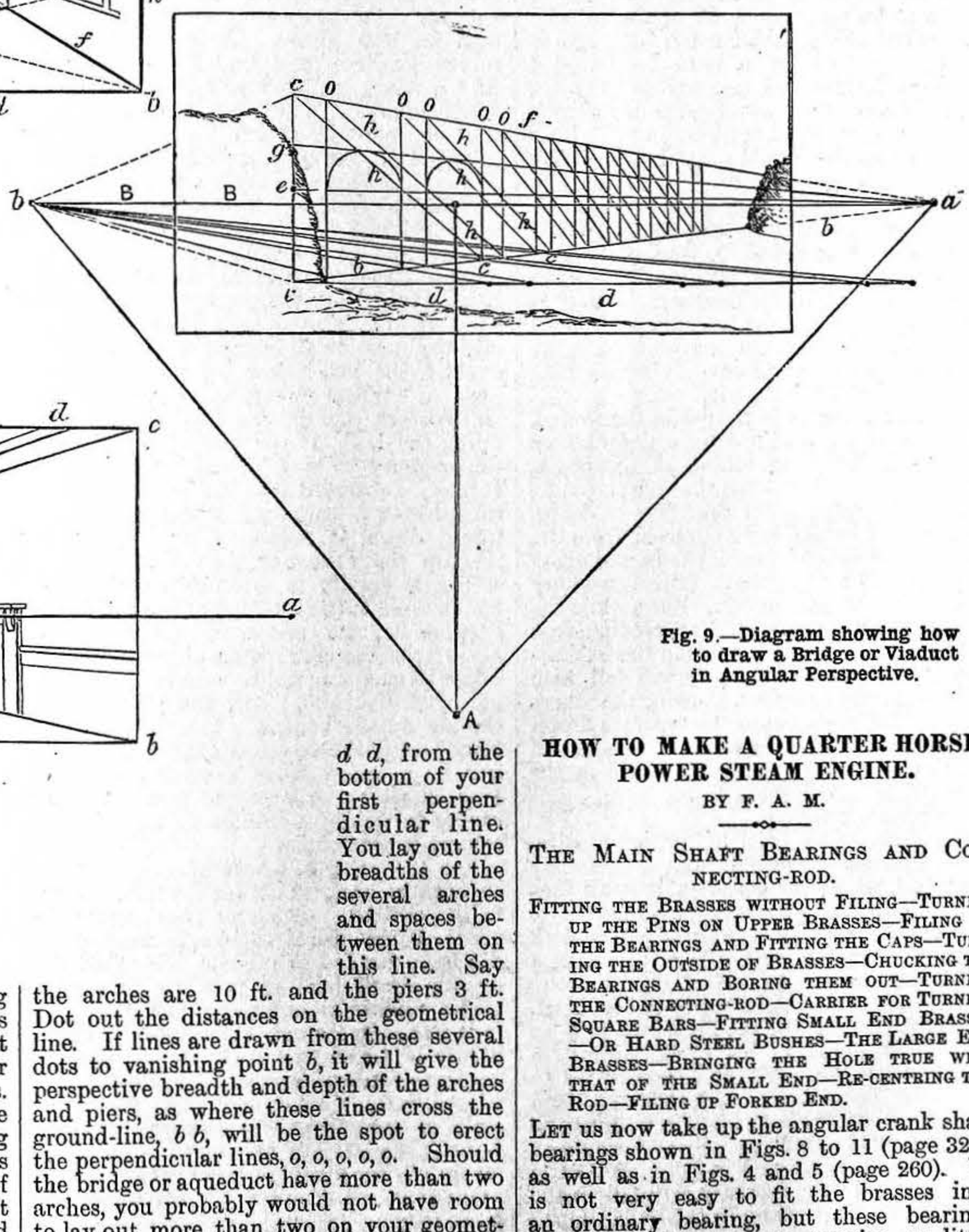

Fig. 9.—Diagram showing how to draw a Bridge or Viaduct in Angular Perspective.

HOW TO MAKE A QUARTER HORSE-POWER STEAM ENGINE.

BY F. A. M.

The Main Shaft Bearings and Connecting-rod.

Fitting the Brasses without Filing—Turning up the Pins on Upper Brasses—Filing up the Bearings and Fitting the Caps—Turning the Outside of Brasses—Chucking the Bearings and Boring them out—Turning the Connecting-rod—Carrier for Turning Square Bars—Fitting Small End Brasses—Or Hard Steel Bushes—The Large End Brasses—Bringing the Hole true with that of the Small End—Re-centring the Rod—Filing up Forked End.

Let us now take up the angular crank shaft bearings shown in Figs. 8 to 11 (page 328), as well as in Figs. 4 and 5 (page 260). It is not very easy to fit the brasses into an ordinary bearing, but these bearings are arranged so as to require as little filing as possible. The brasses are not square or octagonal outside as usual, but round; and therefore they can be turned and their seats can be bored. Lest, however, they should turn in their seats, the

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upper brass of each pair has a pin cast on it, which fits into a hole in the cap, and both prevents all danger of turning and conducts the lubricant down to the journal, without allowing any of it to escape, as it may in the usual form of construction, between the cap and brass. We have two castings of iron for each of the two bearings and two of brass, or rather gun-metal—a harder kind of brass. Begin with the two

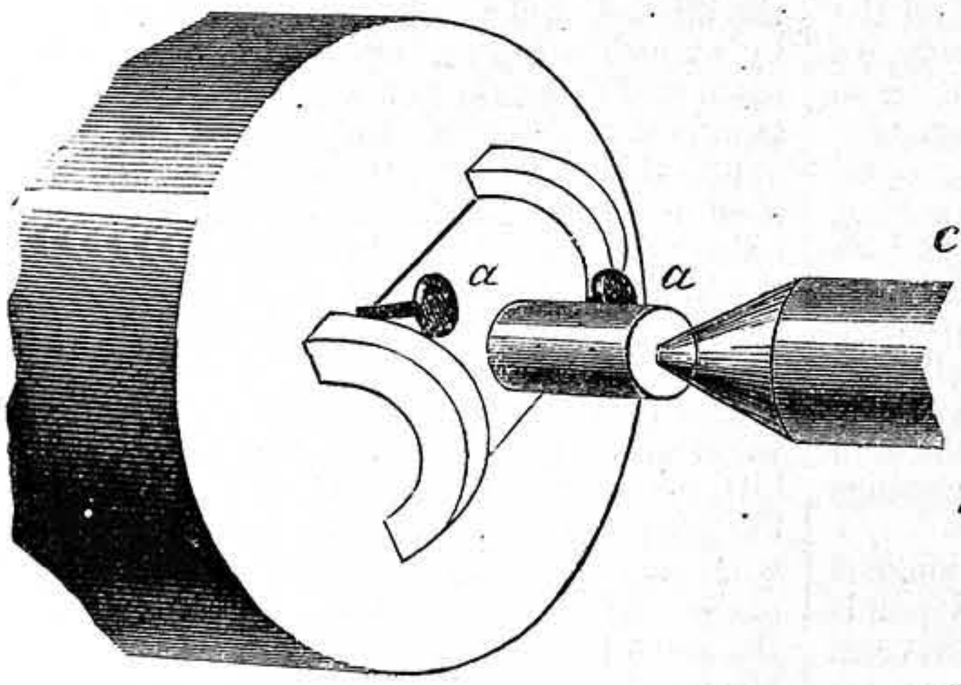


Fig. 47.—Mode of chucking the Upper Brasses.

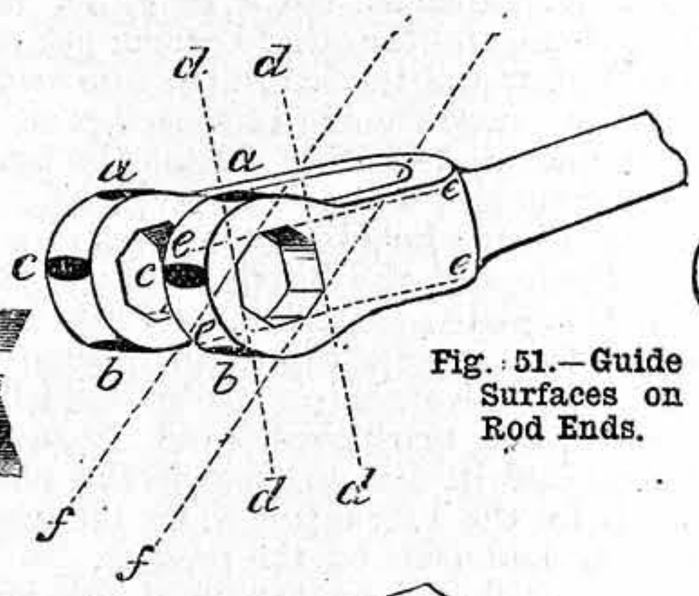
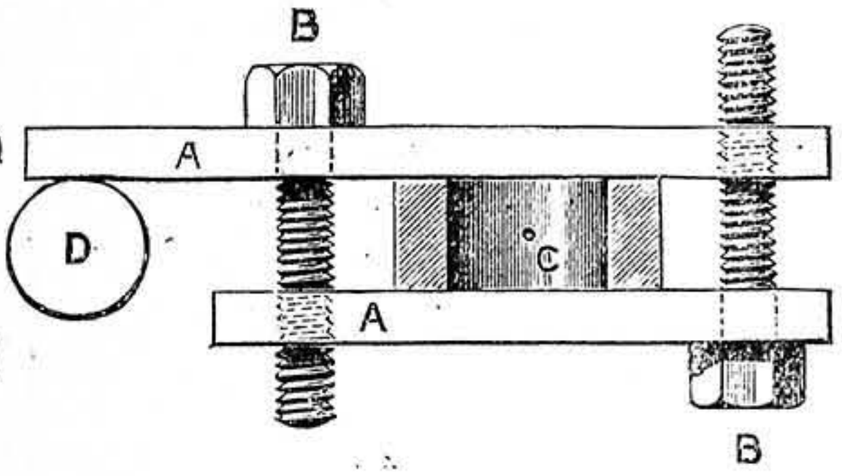


Fig. 51.—Guide Surfaces on Rod Ends.



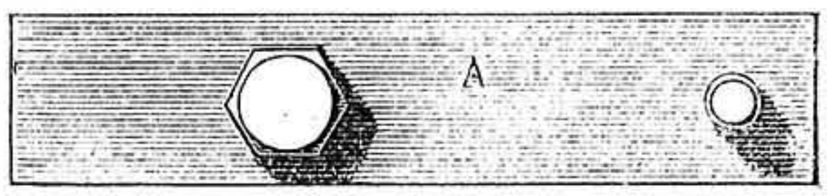


Fig. 49.—Carrier for turning Square Bars.

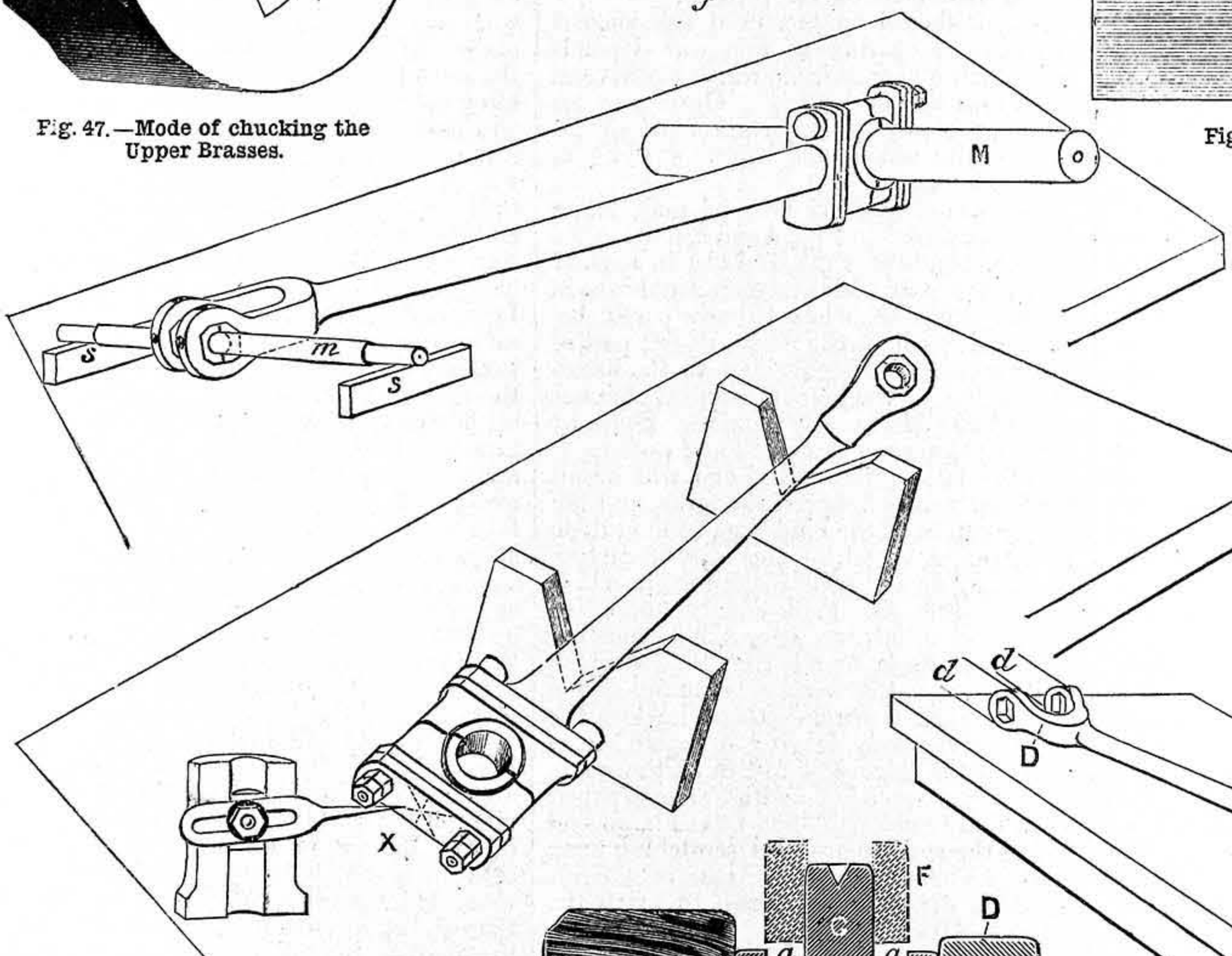


Fig. 48.—Mode of chucking the Brasses.

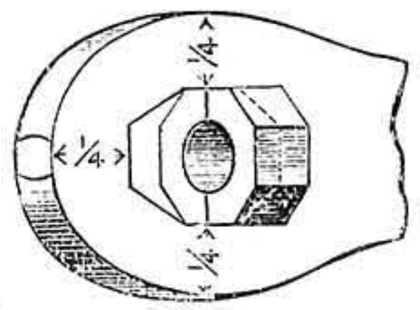


Fig. 52.—Trying the Brasses into Rod End.

Fig. 53.—Mode of adjusting Brasses for Parallelism.

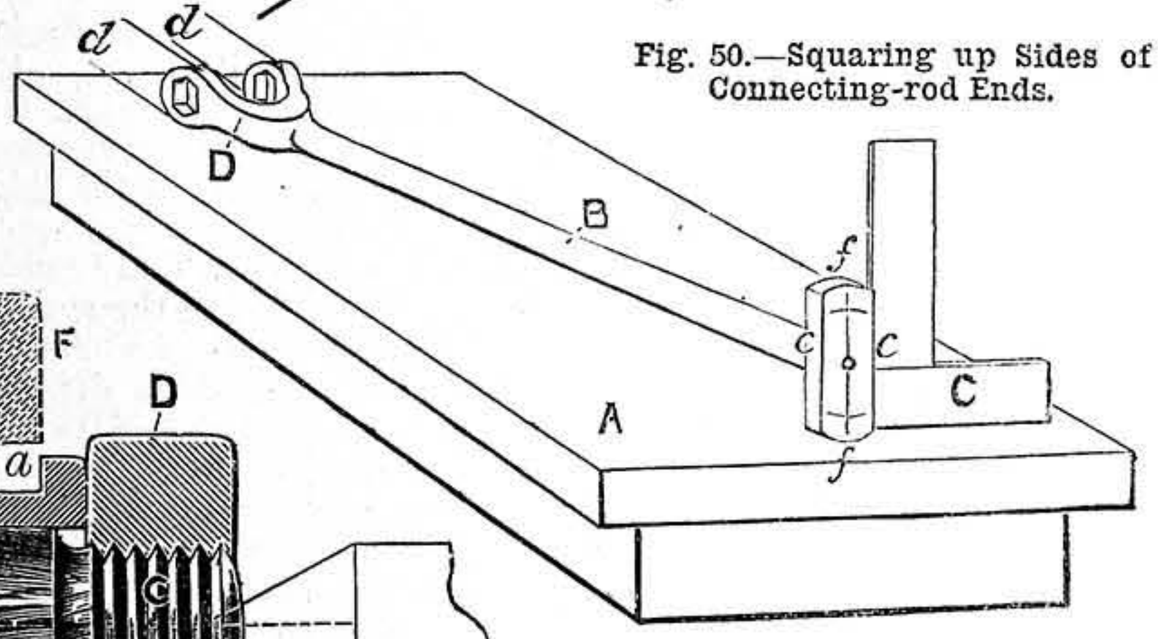


Fig. 50.—Squaring up Sides of Connecting-rod Ends.

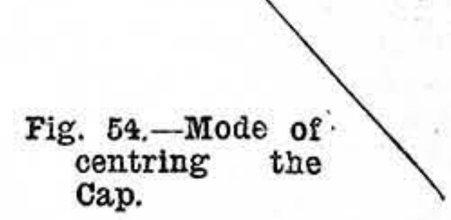


Fig. 54.—Mode of centring the Cap.

upper brasses, which we must chuck for turning the round pins. Rub each of the four brasses upon a file so as to bring up their two edges flat and smooth, and make them semi-circular; take the two upper ones and centre the round pins with the centre punch and drill; put a bit of wood in the lathe and face up the end, which should be about two inches in diameter; lay the half bearing on this and bring up the back centre point to enter the centre hole in the pin, advancing the point till the little casting is firmly held. The pin to be turned is so small that this pressure may be sufficient to hold it against the action of the tool (see Fig. 47); but if not, two nails, *a*, *a*, can be driven into the end wood, so as to ensure that the brass shall turn with the wood. Having turned the pins on both the upper brasses, tin the edges of the two pairs of brasses, and put them together edge to edge, in pairs; heat till the solder melts and they are united. They can now be smoothed out inside with a file till the inside of each pair is fairly smooth, and then they are ready to be chucked by the hole whilst they are turned to 1 in. diameter outside the body (Fig. 11) and on the inner sides of the flanges; but this cannot be done just yet. Lay aside the brasses and take up the two bearings and their caps. File up the soles of the bearings so that they will stand upright and square with the plate; file the sides of the bearings, bringing them to $\frac{3}{4}$ in. in thickness (Fig. 8). Now fit the caps in: the opening where they go measures 1 in. It must be as much as that, or the bearing brasses could not be put in, but it would not hurt if it were a little more, provided only that the caps fit well, without shake. Fit the $\frac{1}{4}$ in. screws that hold down the caps, provide nuts, and bolt it down; file up the sides of the caps level with the sides of the bearings. The reason for filing the sides of the bearings true first, is, that then the sides of the opening for the caps can be got square with the flat sides of the bearings. Now file the under-sides of the caps, both under the ears, or lugs, and under the edges of the projection, so that they will stand up square on these surfaces. There is now an oblong projection under the caps measuring 1 in. by $\frac{3}{4}$ in., and we can chuck them by this so as to bore the $\frac{7}{16}$ in. hole exactly in the centre of this projection. Chuck a piece of hard wood, turn it about $2\frac{1}{2}$ in. in diameter, and face it up; make a recess $\frac{1}{2}$ in. deep, and enlarge it gradually till you can press the projection of the cap into it with the fingers: this will centre it truly. Now pass a couple of wood screws through the screw-holes in the ears to secure them to the wood chuck; starting it with a graver, bore a $\frac{7}{16}$ in. hole, into which the pins on the upper brasses can fit easily. Treat the other cap in the same way. We may now go back to the brasses,

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which we left soldered together in pairs, the pins being turned and the holes being filed out fairly round. Unfortunately, we cannot drive them on to a mandrel to turn them because that would burst them apart; we must therefore adopt another method of holding them. Make a chuck of hard wood (Fig. 48), A; turn down a pin, or short mandrel, B, on which the brasses, E, can fit; cut a screw, C, on the end, and fit a nut, D, so that the brasses may be pinched between the nut and the shoulder of A, and held without any tendency to burst asunder the soldered joint. A rather easier way would be to cut off the pin, B, where the screw begins, and, instead of a nut, have a bit of flat wood to receive the back centre point and transmit to the bearings the pressure of the back centre screw; this does away with the necessity for cutting screw, C, and its nut, but it is not so good a plan, because the point of the back centre will gradually indent the bit of wood, and diminish the pressure on the bearing, which may then turn round on the pin and require to be trued up again. The plan shown at Fig. 48 will not relax its hold, and, if the cutting is carefully and cautiously done without catching against pin G, the necks, *a*, *a*, can be turned to exactly one inch in diameter, the outsides of the flanges, *c*, *c*, to 1¼ in. in diameter, and the inside edges of the flanges, *b*, *b*, can be turned true. In doing these last, the cap, F, would be tried on to the turned pin, G (see Fig. 48), and the flanges turned away till the cap will just go down between them when put over the pin. It is much easier to *turn* the inside of these flanges true than to *file* them. The caps and the tops of the pins of the brasses should be marked so that the caps may not be exchanged nor turned half round, since, if the hole in the caps were not absolutely central, they will not fit both ways. Now, though we have turned the bands, *a*, *a*, true on each side of the brasses, there is a band $\frac{7}{16}$ in. wide in the middle which cannot be turned on account of the pin; it will, however, be very easy to cut this down level with the two side bands with a little sharp chisel and files, and so make the rest of the outer surface almost as true as if it had all been turned.

We must now return to the bearings. Fit on their caps, screwing them firmly down; then take the face-plate and angle-plate we used for boring the crosshead. If the angle-plate has not been moved, it will be in exactly the right position for boring the bearings, since their centres should be 1¾ in. high, the same as before; if the angle-plate has been taken off, it can easily be replaced by means of the same little template (Fig. 40, page 420). Bolt the bearings upon the angle-plate one at a time, so that their sides shall be exactly parallel with the face of the plate, standing up perpendicularly from the top of the angle-plate. To test your work, bring up a tool and let it touch the circular facing, on bearing and cap, as it goes round, when it should touch equally, or nearly so, all round. Now bore out the seat for the brasses to 1 in.: take off the cap and try the brasses in. The flanges have been fitted to the sides of the cap, and the cap has been filed to the same thickness as the bearing, therefore the flanges of the brasses should fit the bearing equally well; they should require a little gentle rapping to drive them down into their seat: it would be very bad indeed to have them loose. Having got one pair of brasses down solidly on to their seat, put on the cap and nuts, screw them down, and bore out the brasses to ¾ in.; face up the front of the brasses, and round the corner at the mouth of the hole. In Fig. 5 these corners will be seen dotted; looking at the crank shaft, where it passes through the bearings, it is seen reduced from ⅞ in. to ¾ in. in diameter; but shafts of this kind are never cut into by a square corner, but always by a little quarter circle, which leaves them much stronger. Now, therefore, we must round the corner of the hole in the brasses to a little quarter circle of $\frac{1}{16}$ in. radius. This done, and the other bearing put on the angle-plate and treated in the same way, we must re-chuck them in a reversed position so as to face up the other side of the brasses; turn them half round on the angle-plate, and adjust till the hole in the brasses runs true, and the face of the bearing is parallel with the face-plate; then face the brasses and round the corner with a $\frac{1}{16}$ in. quarter circle as before. Now warm the brasses till they come in two, mark them carefully and their bearings, drill the oil hole in the pin, and tap it for the lubricator, when the bearings may be laid aside for the present.

Here it should be remarked that success in fitting a bearing of this sort depends very much on *the order* in which the several operations are performed. Order, or sequence, is always of importance, and should be carefully considered before a piece of work is begun.

The connecting-rod may be undertaken next; it appears in Figs. 4 and 5, uniting the crosshead and the crank, and also in Figs. 12 to 15 (page 328), where its ends are shown in detail; it has been left till now partly because it is perhaps the most difficult part of our work. The difficulty lies in the necessity for having the holes through the brasses at the two ends exactly parallel. Begin by centring the connecting-rod and putting it into the lathe; the forked end will admit the lathe centre between the forks, and the carrier can be of the kind used to hold upon a square. A sketch of this sort of carrier, which any amateur can make for himself, is given at Fig. 49. It is simply formed of two pieces of flat iron, A, A, A, held together by two screws, B, B; C is the connecting-rod end, seen in section, and D is the pin of the driver chuck. Having then chucked the rod, turn the body, leaving it tapered from $\frac{9}{16}$ in. at the large end to ⅜ in. at the small, and nicely polished with emery-paper. Turn up the oblong flange at the large end facing the end square, and scratching upon the end surface two short arcs of a circle 1¼ in. in diameter, on which to mark the centres of the bolt-holes. The only parts now remaining of the large end of the rod not got up bright are the sides of the end flange, and these must be filed up with reference to the small end of the rod. Lay the rod down on the surface-plate so that it rests on the fork at one end, and on the end of the flange at the other (see Fig. 50). A is the face-plate, B the rod, and C the square. The edges, *c*, *c*, of the end of the rod must be filed up square with the small end, but this can only be done if the depth of both the eyes, *d*, *d*, are equal. Having tried the surfaces, *c*, *c*, with the square, we file little flats under each eye for the rod to rest on—which little flats will be useful as guides hereafter—and in filing them we may take a trifle more off one eye than the other, so as to bring *c* and *c* upright, if it be not so already. Now file up *c*, *c*, making the flange a little over ⅝ in. wide, so as to allow a little for after correction, but bringing both surfaces square and parallel; then turn the rod over and file two other little surfaces on the other sides of the eyes, so as again to bring *c*, *c*, vertical; this will make the distances, *d*, *d*, at D, equal. Draw a line with the scriber point down the centre of the flange at *f f*, to determine the centres of the bolt-holes, and centre-punch the intersection of this line with the arcs marked with the lathe tool. Looking now at Fig. 51, we have two little flats on each eye, *a*, *a*, *b*, *b*, square with the flange at the other end of the rod; we need, however, two other guide surfaces (*c*, *c*) before we can attack the octagonal hole for the brasses, and these surfaces are obtained by standing the rod up vertically upon the plate and filing the surfaces, *c*, *c*, till the rod stands straight up as tested by the square. When this is done the three surfaces can be used as guides for filing out the octagonal holes; distance *a* to *b* being 1⅛ in., then the thickness of metal from *a*, *b*, and *c* to the adjacent side of the octagon will be ¼ in. In order to mark the lines *d d*, *d d*, at right angles to the length of the rod, put a bit of wood under the end, at D, Fig. 50, so as to bring the rod horizontal and level with the plate; then these lines can be marked with a scriber by squaring up from the plate. Lines *e e*, *e e*, too, can be drawn at the same time with the scribing block. In filing out these holes the little square file will pass through both eyes at once, so that it must run straight, and the lines *d d*, *e e*, will be marked on the outside of both eyes; then, by taking ⅛ in. in the callipers, and making that the thickness of the metal inside each of the little guide surfaces, we can hardly fail to get out the holes correctly. Lines *f*, *f*, can be drawn with the scriber by means of an ordinary set-square (for drawing) of 45°, resting on the face-plate, whilst the rod is packed up level by means of the bit of wood. Now take the four little castings provided for the brasses of this end, and, rubbing their edges upon a file, tin and join them in pairs with solder. Now take each little couple and rub on a file, so as to get up one side true and level from which to work; then begin with two opposite sides of the octagon—say those which fit against *e e*, *e e*—make these square with the first face, parallel with each other, and leave them just so far apart that you can almost push the brass into the hole sideways. Fig. 52 will make this plain. The brasses being only $\frac{5}{16}$ in. thick, and the top and bottom sides of the octagon a little more, it is possible to try the two first sides of the brasses in that way; but as the octagon is not a true one, but somewhat elongated, the other six sides being shorter than $\frac{5}{16}$ in., we cannot try the other sides of the brasses in, and must trust to careful measurement until they will begin to drive in a little way, when the shape of the hole in the rod will get marked on them, and they can be filed accordingly, keeping every side square with the first face and making sure that they fit tightly so as to require a little gentle driving to get them in. Having fitted the two pairs of brasses into the forked end of the connecting-rod, we may proceed to bore the hole, or rather enlarge it, to the size for the crosshead pin by means of the ⅜ in. fluted reamer. Begin by passing through the holes a small round file, using it very carefully so as not to get the hole askew; enlarge it gradually, stopping continually to measure with callipers from the hole to the three test surfaces. As soon as the ⅜ in. reamer will enter, use it to round the hole and measure again, then correct with the file if needful. Of course, it is very important that both sides of the fork should bear equally on the crosshead pin. To ensure this, test still further by

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turning a little iron mandrel, about 4 in. long, to the same taper as the reamer, so that it will fit into the holes where the pin goes (see Fig. 53); then turn a bit at each end to, say, ¼ in.; now pass this mandrel into the two holes and stand the connecting-rod up vertically on the face-plate. Now you can measure from the plate up to the small diameter (¼ in.) at each end of the little mandrel to prove whether the mandrel is perfectly parallel with the plate and therefore square with the length of the rod. If not, ease the hole inside with the file, and round it again with the reamer. The reamer must finally be worked into exactly the right distance so as to make the hole about the same size as that in the crosshead; the pin should, however, fit more easily in the brasses than in the crosshead, in which latter it should be driven pretty tight, and further secured with the set-screw. The brasses then being driven into their places in each side of the fork, and the hole for the pin being finished, we must cut the two little slots for the cottars or wedges which tighten the brasses. Looking at the section of the crosshead in Fig. 5, the cottars are seen cutting into the brasses; this is to keep them in place, and it would prevent the fork end of the connecting-rod from slipping sideways. This, however, is already prevented in our case by the crosshead fitting between the fork, still it may serve to keep the brasses in place when the rod is taken off. These little holes must be cut by drilling from both sides and finished with small files and much patience. The cottars should be of steel, and may be hardened and spring tempered.

Here I may say that it would be easier, and perhaps as efficient, to insert hard steel bushes or ferrules in the fork ends, and to harden the crosshead pin instead of fitting the brasses and cottars. True, there is no means of taking up wear in that case, but the movement of this joint is very small, and, if both bushes and pin are hard, the wear will be almost inappreciable; moreover, it is always possible to make a new pin and to insert new hard bushes. To fit the fork end this way, we should have to file out the octagonal holes, round, in connection with a ⅜ in. fluted reamer, using the same precautions to ensure the hole being square with the rod which have been described when the hole in the brasses was being adjusted. The crosshead pin would be made of cast steel, and hardened; the steel bushes would be bored slightly small, turned on a mandrel, hardened, driven tightly into place, and then ground out by working an iron or brass rod with emery and oil through both bushes while in position in the rod end, the iron or brass rod being turned to exactly the same taper as the crosshead pin.

We must now complete the large end of the connecting-rod as seen in Figs. 13, 14, and 15 (page 328). Unite the two brasses with solder as before described, and file up the end surfaces parallel with each other; mark the positions for the bolt-holes and bore them; make the little oblong cap of steel and bore similar holes in it. By means of these bolt-holes, the brasses, with the cap, can be secured to the angle-plate on the face-plate of the lathe whilst the hole in the brasses is bored out, faced, and the corners, seen at Fig. 13, rounded. The next operation will be to bore the holes for the bolts in the end of the rod; one of these holes may be bored first and the bolt fitted; but, before we bore the other, we must take certain precautions to ensure it being so placed that the hole through the brasses at both ends of the rod shall be parallel. The bolts to secure the large end brasses should be of mild steel, and the nuts should be hardened; the holes they fit in should be cleaned out with a ¼ in. taper reamer. The bolts are shown in the drawing with the heads inside and the nut outside, which looks best, but necessitates the reamer being put in from the rod side, which is not very convenient; however, the reamer may be put in from the cap end, and the bolts may also go in that way if preferred; the body of the bolts should be turned to fit well into the holes. To ensure the holes at both ends of the rod being parallel, and not, as carpenters would say, "in winding," fit two turned rods into the holes, using them as winding strips, the cap and brasses of large end being secured by the one bolt first fitted. We have already fitted a small mandrel to the small end of the rod (see *m*, Fig. 53); the small end of the rod may be supported on this by means of the two small strips, *s*, *s*, which are of equal width; the other end of the rod rests on the face-plate. Now, when the larger mandrel, M, is fitted into the brasses at the large end, it will be easy to see whether M is parallel with the plate; if not, the brasses can be slightly twisted on the one bolt till it is so. When they have been correctly adjusted the bolt may be firmly secured and the ¼ in. drill put through the cap and brasses to bore the remaining hole in the rod, then after cleaning it out with the reamer the second bolt may be fitted. We now require a centre at the top of the cap by which we can turn the whole rod. This can be found by resting the rod on two similar V's, or angles, standing on a level surface, on which the rod can be turned round. This will be easily understood by looking at Fig. 54, where the complete rod is seen lying on two V-pieces; lines are scribed across the top of the cap at ×, the rod being turned partly round between each line, taking care not to move it endways in the V's. These V-pieces may as well be of wood for this purpose, nailed together and cut out both at once; but a pair of cast-iron ones, carefully made, are very useful things for centring rods for the lathe, etc. Having found the centre, as nearly as may be, and made a dot with the centre-punch, the rod may be put in the lathe and brought true with the square centre, then the rounded edges of the head of the rod, brasses, and cap may be turned up and finished, when it only remains to drill a hole for the lubricant, starting from the centre hole just found, through cap and brass; enlarge this hole and tap with ¼ in. thread in the cap, and it is ready for the lubricator; then the sides of the flanges can be filed up, and the large end of the rod is finished. The fork end must now be filed up; the four flat surfaces through which the hole for the crosshead pin passes must be accurately at right angles to this hole or the joint cannot work. We can attain this by using the crosshead pin as a guide. Observe in Figs. 5 and 8 how the head of the pin abuts against one of the sides of the fork; file that side flat first and test it as you do so by inserting the pin with a little red marking under the shoulder; do not be satisfied till the red marking shows equally all round the hole, then you may be sure the first surface is square with the hole, and the other three surfaces can be filed parallel with it by means of callipers. Though, however, the first surface may be square with the hole, before we proceed to file the second or left-hand side surface to it, we must lay the rod on the V's with the finished side up, and, with the scriber, measure from the plate up to that surface; then, after turning the rod round, measure up to the second surface to try how much will have to come off to bring the rod central; also, whether, when both these two first surfaces are parallel, square with the hole, and equally distant from the centre line of the rod, the fork will measure 1⅝ in. from side to side, according to Fig. 8. When all these conditions have been complied with and the two outer surfaces have been finished, the two inner ones, which embrace the crosshead guide, may be filed parallel with them, using the callipers to bring them to exactly $\frac{5}{16}$ in. thick. Now it will only remain to file up the top and bottom of the fork and round the end, take out the three pairs of brasses and separate them where soldered, and the connecting-rod is done at last.

The writer is much afraid he may have wearied his readers by going into such detail, yet though he is well aware that too much has been said to please some, yet others may still wish for even more particulars. All directions as to the use of files and other tools will be spared the readers of these papers, and only those points insisted upon which seem likely to prove stumbling-blocks to those who are already fairly proficient in handling the tools themselves. Though much time and space have been given to the connecting-rod, the directions given are such as should throw light upon fitting in general, and may be useful even to those who never attempt to make such a thing as a ¼ horse-power steam engine. Having, however, got thus far in our work together, we have overcome the most important obstacles, and both work and description may perhaps proceed somewhat more quickly from this point.

TWO FOLDING BOXES:

WITH LEGS ADAPTED TO USE AS COMBINED TRAVELLING CASE AND TABLE.

BY J. SCOTT.

"THERE is nothing new under the sun." These words are constantly ringing in the ears of the designer, and no doubt there is a great deal of truth contained in them. But I think I may venture to say that, in the boxes shown in my illustration, I have succeeded in producing something that is new, novel, and useful.

Personally I prefer box No. 2; but, as No. 1 may probably be mostly admired, I have considered it best to give them both.

Who has not, at some time of removal, found the inconvenience of packing up the small odds and ends—things that seem nothing when lying scattered about on tables, shelves, and in cupboards? Boxes may be provided for the time being, but they eventually become as great a nuisance as they were previously an assistance. These boxes, then, supply a want in this direction, and they will also be found handy as travelling cases.

I have also given illustrations of some suitable legs, so that when these boxes are folded they can be made to serve as table-tops.

Very little skill is needed for making these articles. The putting on of the hinges will perhaps be the most trying part, seeing that one box has eight pairs, and the other six pairs. But it must be remembered that,

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if it were not for these hinges, we should not be able to stow our box away into so small a compass.

The size I have represented Figs. 1 and 2 as is 2 ft. square by 1 ft. deep. Of course, they can be made larger or smaller, and of a different proportion; but I shall only proceed to describe the size I have given.

For Fig. 1, then, we require six boards, each 1 ft. wide by 2 ft. long, and one board 2 ft. square. All these boards should be of the same thickness, either ½ in. or ¾ in., according to the strength required.

The large and side boards require canting on the edges all round, so that when any two of them are placed edge to edge they will stand at right angles to each other. The other two boards should each have three of their edges canted, leaving one long edge on each free to receive the fastenings.

Through the four boards, which will form the sides of the box, holes should be bored, large enough to admit of the free movement of a thin rope. These holes would be best if they are bored on the angle, following the line of the rope, instead of being bored straight through.

When all the boards are ready, place them in their proper position, and mark off where the hinges are to go. The two top pieces should be hinged on to the two sides to open *outwards*; these sides, in their turn, should be hinged to the bottom of the box, to shut *inwards*. The two remaining sides will require hingeing on to the bottom, to open *outwards*. The fastening on of the lock, and the placing of the rope, require no commenting upon.

Fig. 2 now occupies attention. The size of each separate board varies slightly from those of Fig. 1, although it is exactly the same size when expanded.

We need two boards, each 2 ft. long by 1 ft. 11 in. wide; two more, each 1 ft. 11 in. long and 11½ in. wide; and four, each 2 ft. long by 6 in. wide. The only parts that require canting on these pieces are the two edges on the *width* of the bottom board, and the bottom edges on the inside of the two ends. The top edges of these ends will each need a lock.

The hingeing of these boards will be a more "ticklish" job than in fastening those of Fig. 1 together. It will be found best, I think, to hinge two of the narrowest pieces together first. These form one side, which will need to be hinged to the bottom and top boards, so that it will fold inward. Then hinge each of the other two narrow pieces in a corresponding position on the opposite side to the bottom and top. The two ends will then require to be hinged to the bottom board, to open outward. It will be found an easy matter then to fix the two remaining hinges.

It will be necessary to have handles fitted to some part of this box. These should be sunk in the same manner as that adopted in an ordinary travelling trunk, so that they will not prevent the boards from folding flat together. The rope will be found sufficient for box No. 1.

Box No. 2 may be made exactly 2 ft. square each way, by making the four side pieces, which fold in together, 12 in. wide each, instead of 6 in.; and by making the end pieces 2 ft. by 1 ft. 11½ in., instead of 2 ft. by 11½ in.; and by fastening one to fold over on to the top, and the other to fold under the bottom. This will necessitate the top and bottom boards respectively to be canted on one of their edges only.

Now we come to the legs, by using which the box can be made to serve as a table. In Fig. 3 we have four legs, each 27 in. long, 1½ in. square at the top, and gradually tapering down to 1 in. square at the bottom. Four pieces of ¾ in. stuff, 1½ in. wide and 15½ in. long. Also four pieces of ½ in. stuff, 1½ in. wide at the centre end, and 1¼ in. at the outer end, which are fastened to the legs.

The square centre blocks should be 1½ in. square and ¾ in. thick. The turned piece which is joined between these two squares may be of any length, but I should advise 13 in. long and 1 in. thick. The longest wooden strips are for the top, and should overlap the legs by about 1½ in. It will then be found that the weight of the folded box will be sufficient to keep the legs from collapsing.

Perhaps it will be said that there is too much hingeing on these legs. But, of course, in giving publicity to the design I do not compel the reader to make an article accordingly; and, so that it may not be said that it is a matter of "Hobson's choice," I have also given the design, Fig. 4, which requires nine hinges instead of sixteen.

The longest pieces of wood shown in Fig. 4 are 30 in. long, by 1½ in. wide at the top and 1 in. at the bottom. The three pieces on to which the table-top rests are 10 in. long and 1½ in. wide. The other three pieces are 1½ in. wide at the top end and 1¼ in. wide at the bottom end. Both the ends of these last three pieces should be canted, so as to allow them to fit nicely to the other parts when used as a table support.

The triangular block in the middle of each leg will have to be very firmly put on, as a great weight will rest on them.

The triangular centre-piece will be 2½ in. wide on each side. As the legs, when folded, come underneath this block, it will be found necessary to cant them on their inside edges. The thickness of all the wood used in Fig. 4 should be ¾ in.

Perhaps it will be best to fasten all the hinges on to the thickness of the wood.

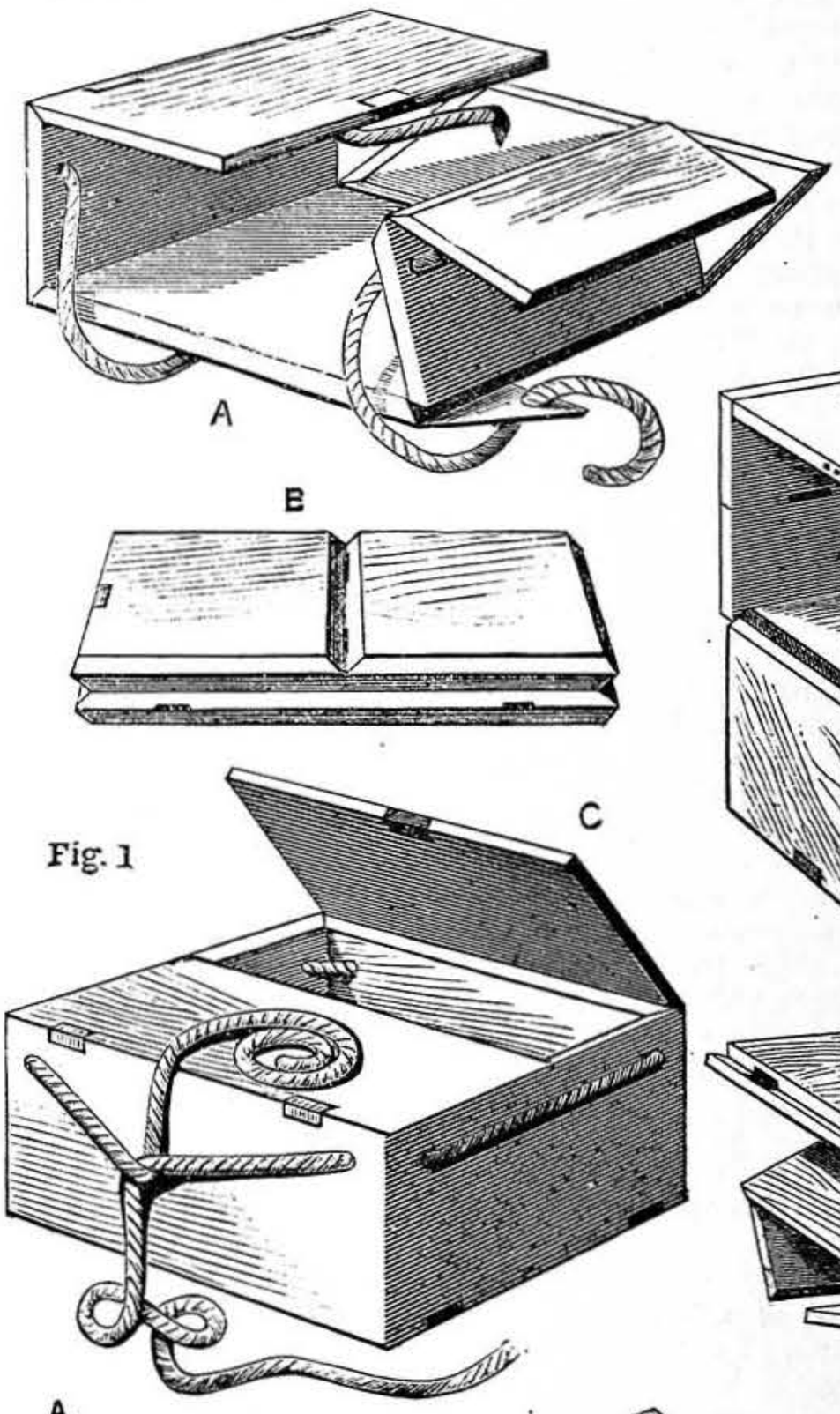

Fig. 1

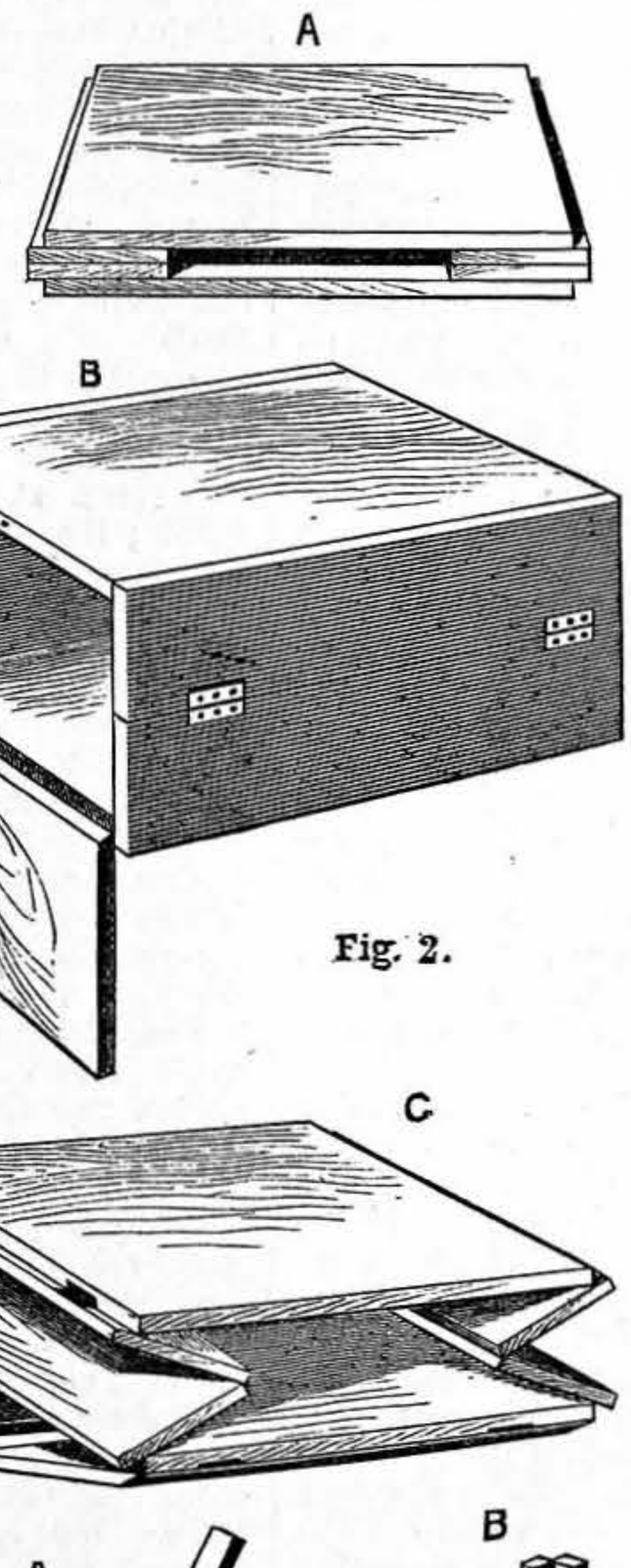

Fig. 2.

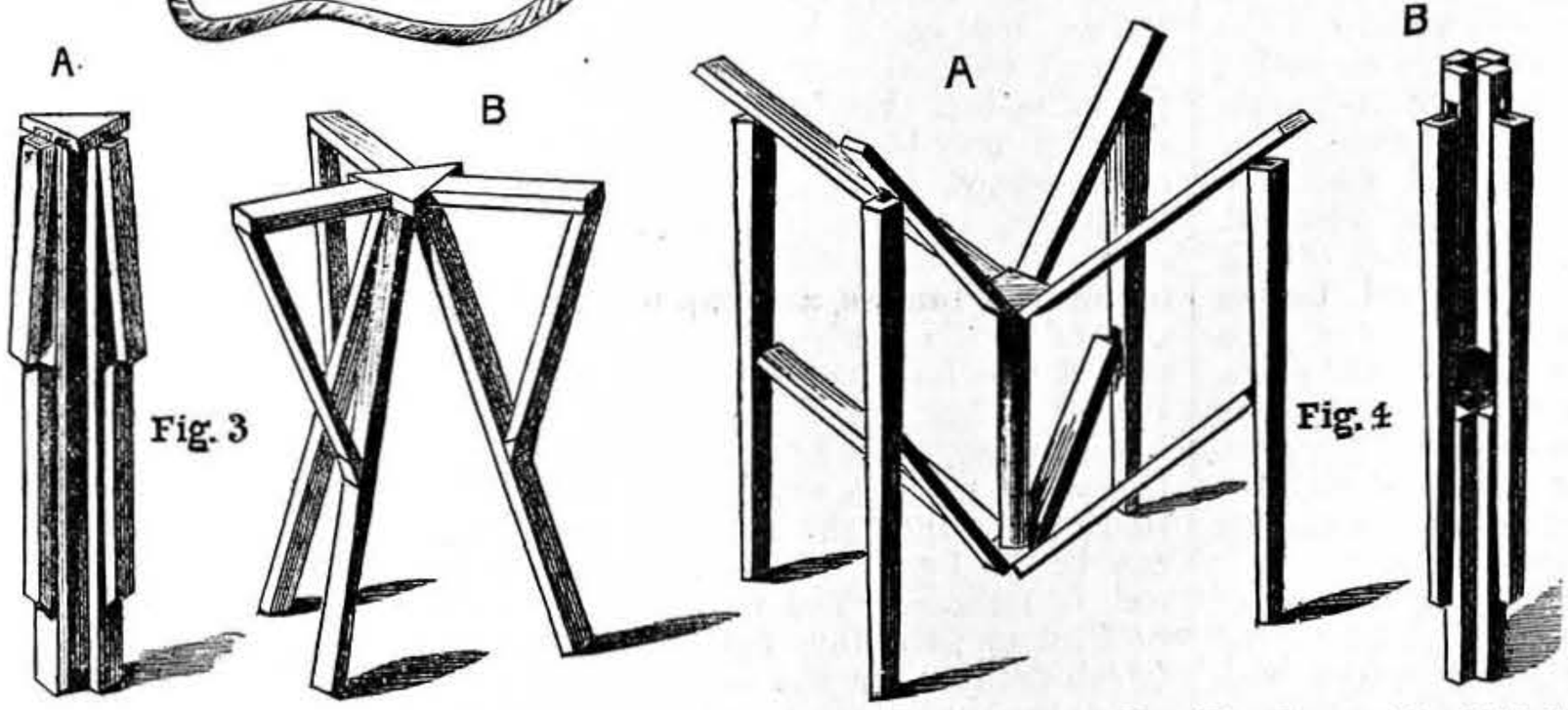

Fig. 3

Fig. 4

Fig. 1.—Method of folding Box (A), Box folded (B), and Box ready for Use (C). Fig. 2.—Box folded (A), Box ready for Use (B), and Method of folding Box (C). Fig. 3.—Legs forming Stand for Box, folded (A) and unfolded (B). Fig. 4.—Ditto, expanding (A) and folded (B).

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None of them will show them. The same with fixing the hinges on the box. If a little judgment is used none of them need be exposed to the eye.

I have represented them as fastened on to the surfaces of the wood, so that thereby I might indicate the position of them, and show in which way the wood is to fold.

I think there is nothing so boring as to read certain statistics, such, for instance, as the number of miles Mr. So-and-so's bank-notes would reach if placed end to end; or the height Mrs. So-and-so's sovereigns would attain if placed one above another, but at the risk of being termed a bore, I will give just one or two statistics of these boxes.

Two hundred and two 4 ft. square and 2 ft. deep boxes, standing one above the other, would reach as high as the top of St. Paul's—which I have always been given to understand is 404 ft. high—but when folded they would only occupy a space of 4 ft. square by 33 ft. 8 in. high.

Again, ninety of them, 2 ft. by 1 ft., filled with articles, would fill a pantechnicon van 10 ft. long by 6 ft. high and 6 ft. wide; but when compressed together the pile would be but 1 ft. high. I give these figures to show to what use these boxes may be put with advantage.

A PATENT RUBBER FELLOE WHEEL.

BY JOHN C. KING.

About two years ago an article in the *Saddlers' Gazette*, on the use of rubber in carriages, received the tribute of appreciation by transfer to foreign journals. Here is something coachmakers have long sought for—a hard-tired, perfectly round-rimmed wheel, suspended in rubber, free from contact with the ground.

A shrewd man of experience remarked that "the merit of using rubber in carriages was at present not very great: plastering it on the sole of an iron-shod wheel, or wedging a piece of it between spring and axle—the one to wear out quickly as well as augment draft on good roads; the other, to produce a loose bearing where a tight one was wanted."

He rode on a vehicle with the rubber protected by a tire, as illustrated, and further remarked—"Here is successful genius—applying rubber in so small a quantity as to be economical and in such a manner as to be indestructible, while effecting its purpose of saving riders from traffic noises (and the street dwellers also), and relieving the shoulders of the horse from the effects of wheel concussion with road obstacles, and, above all, saving the rider's spine, heart, and brain from jars incidental to hard-tired vehicles."

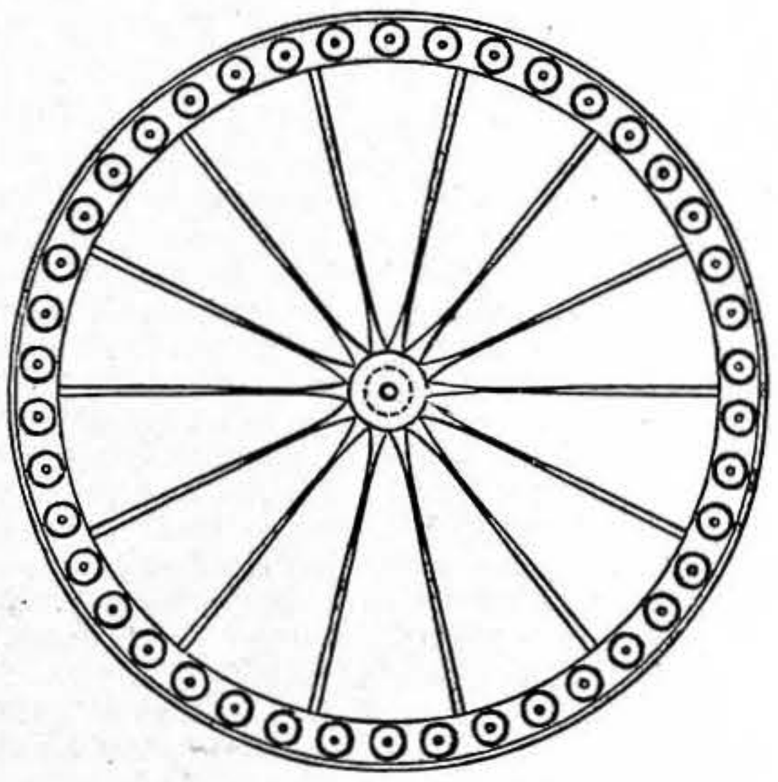
It will be obvious that the rubber ring felloe wheel is a spring wheel within a rigid circular hoop, the rings at bottom forming flattened ovals in shape, and at top vertical elongated ovals, as the rings there suspend the wheel and the superincumbent load. The action of obstructions the wheel surmounts is to compress the rings, which, when the obstruction is surmounted, causes the tire rim to bound forward by the released compression of the rings. A hundred miles' drive on very muddy roads showed that the ever-alternating shapes of the rings kept them from holding mud, so that splashing is less than with ordinary tires.

These wheels seem destined to develop new aspects of coach-making, as they and the superstructure may be so much lighter in wood- and iron-work, and the springs may be lighter for heavier loads.

Already a new cab company, with hansoms two-hundredweight lighter, with room for three riders on the seat, is being formed. This will be an immense advance in economy for cab-owners in the wear of their horses and harness, and allow cabmen to do quicker work with less fatigue to their horses or themselves; for it must not be supposed that cab-driving is free from fatigue to the men, even in the best weather for such work.

The only difference in this wheel to ordinary wheels in its make is the double tires, with the rubber rings riveted between them.

The spoke-tire is of T-shaped iron, the stem of the T being notched into the spokes and riveted there. To this spoke-tire is clipped the rubber rings of suitable strength for a 4 cwt. dog-cart, which will eventually be ½ cwt. less. A twelve-spoke wheel has thirty-six rings. The outer or wearing tire is of ⊏ iron, the rubber being clipped to the outer side of the ⊏. The hollow is filled with a hard, light, durable composition.



Patent Rubber Felloe Wheel.

These tires are 1 in. wide on the sole, and about ⅞ in. deep in the channel. When the wheel revolves rapidly the rings are not visible.

They may be placed sideways or end on. The above is an illustration of the wheel.

A RUSTIC FLOWER-HOLDER FOR TABLE DECORATION.

BY OMADAUN.

Its Form—A Gipsy Tripod—Natural Sticks to be used—A Cocoanut Shell for Flower-holder.

So very rustic is it, indeed, that it is almost with an apology that I present it to my fellow-readers; yet in its extreme simplicity there is somewhat of a charm, which I need hardly say is greatly enhanced if taste is displayed in the arrangement of the flowers; and having recently made one for my own dining-table, which has called forth great admiration, I am tempted to hope that a description of it may prove acceptable to others.

I can hardly claim for it any novelty of form, which, it will be seen, is simply that of a gipsy tripod, and the novelty—if it can be so called—lies rather in the simplicity of the materials used in its construction.

The tripod is formed with six rustic sticks, put together in the form shown in Fig. 1, and being tied with a sort of dried grass, known to all gardeners, I believe, as "bass." There is no attempt made at what I may call "finish," but the sticks must be firmly

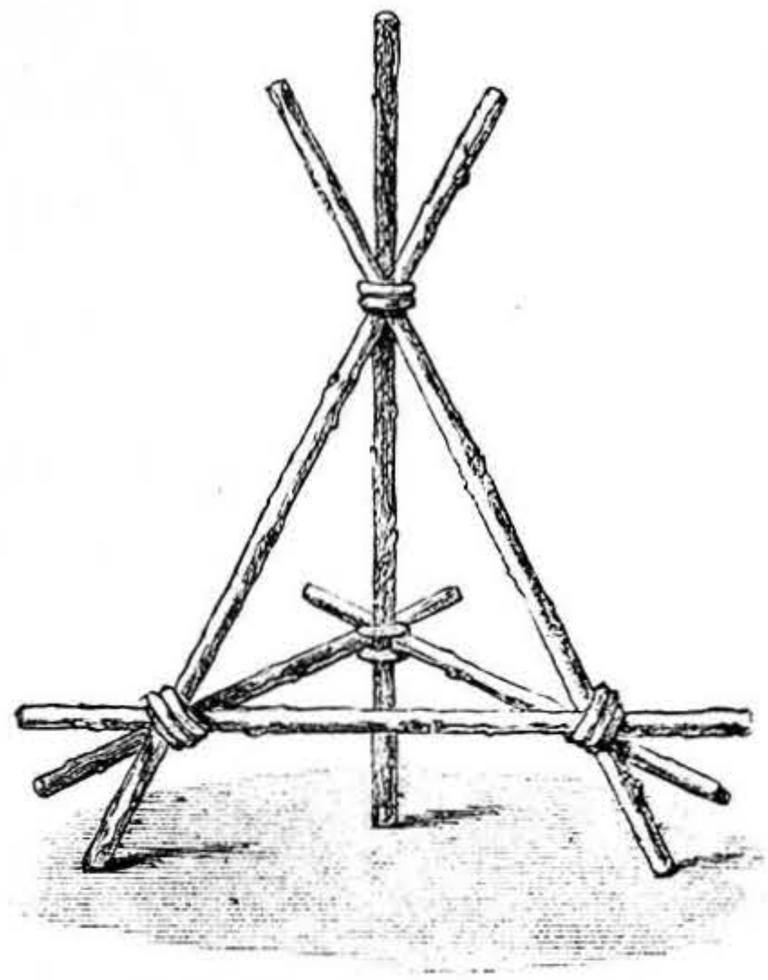


Fig. 1.—Construction of Tripod.

tied together at the joints, and the ends of the bass can be left either hanging loose or tied in a bow. The holder for the flowers is a cocoanut shell, which has been sawn in two, so as to leave one part a sort of cup or egg shape; three holes are drilled at equal distances round the edge (this can be done with a bradawl), and it is suspended from the tripod with three more pieces of the bass, which completes the arrangement. Of course, any small receptacle can be used in place of the cocoanut shell, but that

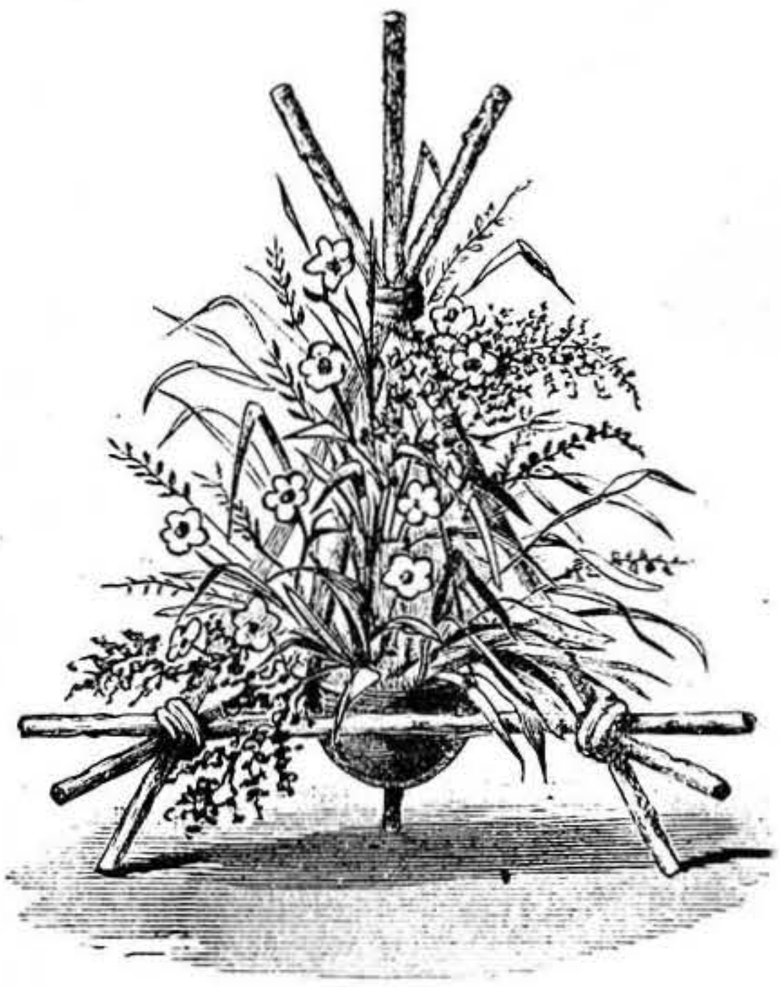


Fig. 2.—Flower-holder Complete, with Cocoanut Vase in Position.

perhaps, carries out its rustic appearance the best, and is very easily obtained.

In Fig. 2 I have attempted to show the tripod when decorated. The effect can be hardly more than "suggested" in a black and white drawing, but I can assure my readers that it is well worth the little time and labour necessary for its construction, which is of so simple a nature that no one need despair of making a satisfactory "job" in putting one together.

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A SIMPLE AND EFFECTIVE DRAUGHT EXCLUDER FOR DOORS.

BY H. HINGE.

INTRODUCTION, MAKING AND FIXING, ETC.

ALL house doors are so fitted as to admit being opened without rubbing on the floor, and it often happens that a little more has to be planed off to allow them to pass freely over a carpet or linoleum. Such being the case, we may expect the door, when closed, to have a space under, through which the air comes freely. In the summer months this is all right, and helps to ventilate the rooms; but in winter-time it is another thing altogether. Most of us have experienced the fact when in a nicely heated room, and, upon the door being closed to make the room more comfortable, we have still been chilled about the feet and

Fig. 1.—Transverse Section of Oak Strip.

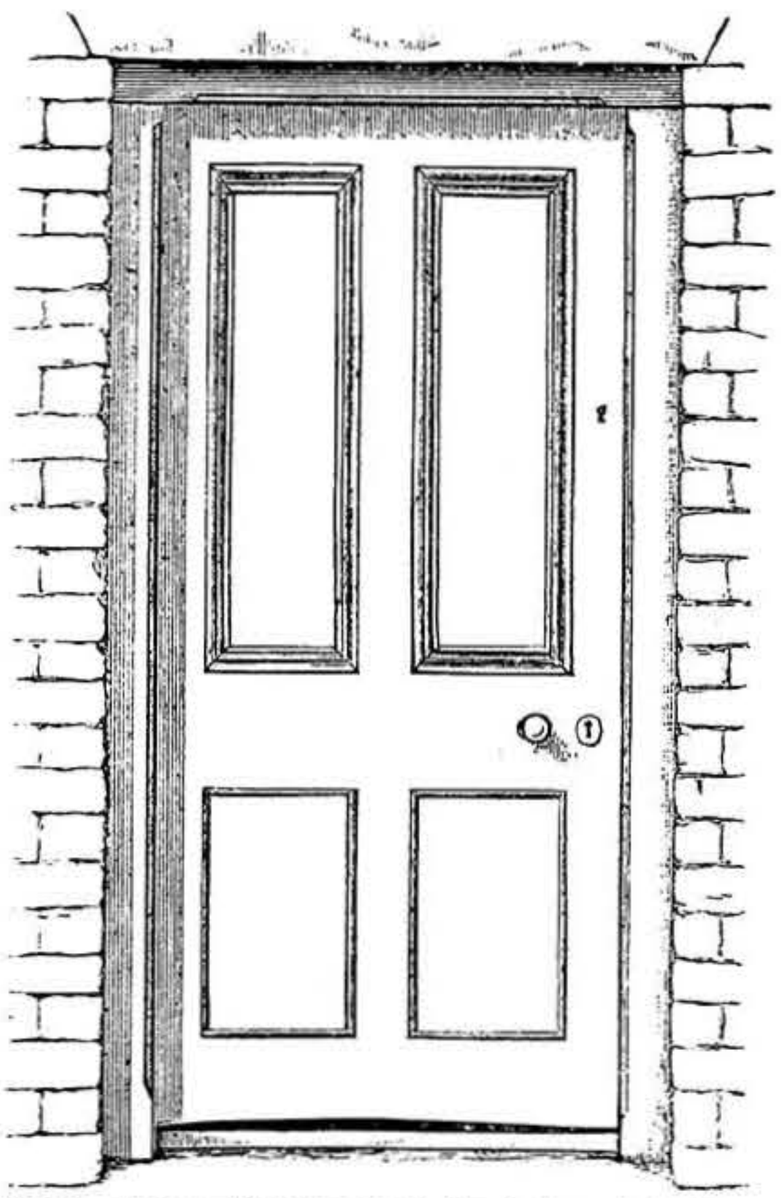

Fig. 2.—Door with Draught Excluder at Bottom.

legs. The cause of this is the draught coming through the space between the door and floor. A simple experiment will at once make this apparent to all. If a match or taper is lighted and held at the bottom of the door, the force of air will, in many cases, extinguish the light. This can easily be obviated by making draught excluders, and fixing them to our doors. The whole operation is so simple and the requirements so small that almost anyone who possesses a taste for mechanics can make and fix them.

Making and Fixing.—Procure a piece of oak, $\frac{1}{2}$ in. or $\frac{5}{8}$ in. thick, $2\frac{1}{2}$ in. broad, the length to be determined by the width of the door-casing (or frame). This must be rounded up till the end appears like Fig. 1, feathering it off on the edges to nothing, and rising gradually to the whole thickness. This should fit in tight (in the length) between the door-casing (or posts), the door closed, and the strip of oak gently tapped up into its place under the door till its edge just fills up the space between the door and floor. The door should now be opened, and a piece of felt or cloth, about $1\frac{1}{2}$ in. wide, tacked along the bottom edge of the door, allowing it to hang below the door about $\frac{1}{4}$ in. Now close the door, and, if it is in its right position, it will pinch up tight against the oak, and be perfectly air-tight. The strip of oak should be stained or painted to match the floor, and screwed down with three fine screws. It can then easily be taken up in warm weather. If it is a stone floor or step, holes must be drilled in it with a small iron chisel, and plugs of wood put in to receive the screws. Fig. 2 shows a draught excluder in position.

OUR GUIDE TO GOOD THINGS.

**** Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of anyone who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

74.—ELECTRICAL NOVELTIES, ELECTRIC JEWELLERY, ETC.

MESSRS. CATHCART, PETO, & RADFORD, electrical engineers, send for inspection eight useful illustrated sheets of novelties in electrical instruments and appliances. This firm has been well known for several years as the makers of pocket batteries and accumulators, made of ebonite, and fitted with lithanode plates. These batteries have been much used for supplying current to small electric lamps on the stage and elsewhere in situations where portable electric lights are desired. In the repair of powder magazines, gas retorts, and steam boilers, these portable electric lamps are a boon. Body belts, to contain curved ebonite cells, are worn by the workmen, who can then freely move about with the electric light in their hats. These belts are sold at the low price of 7s. 6d. each. The firm also supply portable table electric lights and bull's-eye electric lights, from 15s. to six guineas complete. They also make a speciality of electric jewellery, made up in the form of pretty scarf pins and hair ornaments in silver and tortoiseshell set with brilliants, at prices varying from 9s. to 25s.

75.—SHEETS OF FURNITURE DESIGNS.

Messrs. Henry Zilles & Co. have just published some thirty or forty sheets of furniture designs for the use of art workers in wood. For information respecting prices, etc., and a list of subjects included in the sheets already published, our readers must be referred to the publishers, whose address will be found in the advertising pages of WORK. The drawings are boldly done, and treated in a broad and vigorous manner, but the designs themselves, however well calculated they may be to suit continental tastes, are too elaborate in ornamentation to meet the requirements and desire of English makers and buyers of furniture. The designs comprise a large variety of articles of furniture, from the grandfather's clock to the massive sideboard and drawing-room buffet.

76.—NONPAREIL ENAMEL LETTERS.

Mr. James E. Brindley has submitted to me specimens of his Nonpareil enamel letters, figures, trade marks, etc., for fixing to windows, showcases, glass door fanlights, and for fascias, signs, door-plates, and general advertising purposes. The letters and ornamental adjuncts—in the form of rules, corner-pieces, borderings, etc.—appear to be very much like opaque glass, cemented on to plates of clear glass. The method—although it does not apparently possess the merit of being perfectly original—of thus making, at a short notice, very attractive advertising tablets is simple enough. The following exhibits the nature and formation of the cement and the method of fastening the letters on the glass. The cement itself is made of white lead, with a small proportion of plaster of Paris and a few drops of gold size, mixed well together. It is applied to the back of the letter or ornament to be fixed on the glass with a knife, and the letter, etc., must then be pressed firmly in its place. The glass should be perfectly dry and clean before any attempt is made to put on the letters. All superfluous cement that appears round the edge of the letter after pressure must be removed with a piece of wood cut to a point, and the whole must finally be cleaned with dry plaster of Paris rubbed on with a brush. Mr. Brindley claims to make elegant and correctly shaped letters in a great variety of size and form at a low price; but for prices and particulars readers of WORK must apply to the maker, who will readily furnish these on receipt of a stamped envelope. Mr. Brindley is also making a speciality of window name-plates, and speaks of photos of this and another class of article that he manufactures, believing that there are numbers of people who would like what he terms a chaste and attractive display of their name and business from the windows of the ordinary dwelling-house. The other class of article to which reference is made is manufactured for cabinets, carriages, perambulators, cycles, etc. He also supplies alphabets for pigeon-holes, and labels for music drawers—such as "Piano," "Sacred," "Dance," etc.—which have been mentioned before now in WORK as necessary for the proper completion of musical and literary cabinet work.

77.—CLASSES FOR WOOD CARVING.

I am requested to call attention in "Our Guide to Good Things"—and in doing this I have considerable pleasure—to the fact that "The Worshipful Company of Carpenters, in conjunction with the Council of King's College, have established at that college wood-carving classes. The day classes are held on Monday, Wednesday, and Friday afternoons from two till five, and the evening classes on Mondays and Wednesdays from seven till nine. Arrangements have been made by which ladies are permitted to attend, and prizes are offered by the Company. Particulars may be obtained from the Carpenters' Company, London Wall, or of the Secretary at King's College." In thus seeking to give an impetus to the acquirement of wood carving, one of the most attractive of all the various branches of wood-working, the Carpenters' Company are doing their best to carry out a work that especially belongs to them, and in associating themselves with King's College in the task, they are moving in the right direction, for there must be many among the senior and junior pupils there who will be led to take advantage of the classes, and so engage in an occupation which will be a relief to their more serious studies, and perhaps lead up to a further acquaintance with wood-working, which cannot fail to be of utility to them in after life. THE EDITOR.

SUGGESTIONS FOR WORKERS AND HINTS TO INVENTORS.

A SUBSTITUTE FOR PLATINUM.—Amongst the things really "wanted" by the manufacturing world is a substitute for platinum, which at present is found to be the only metal which will furnish wire suitable for connecting the carbons of electric lamps to the current wires. Unlike all other known metals, it contracts or expands under the influence of heat in exactly the same ratio as glass, and can, therefore, be embedded in the bulb necks without danger. It is quite possible that some of the Japanese metal alloys, which are trade secrets in the far East, may possess similar properties; and the matter is, at least, worth inquiry.

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SHOP:

A Corner for Those who Want to Talk It.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

The Copus-Booth "Ideal" Patent Castor.—I must ask the attention of readers of WORK for a few moments to the illustrations of the mode of fixing these castors on round tables and single chairs, as shown in my notice of this decidedly "good thing" in page 410 of the current volume, in which some of the blocks—the small blocks, I should say—illustrative of the castors, and the way in which they should be applied, have become misplaced. I presume it is owing to a misapprehension on the part of the printer to a certain extent, but mostly to the fact that the cuts were not whole and entire as one would naturally suppose them to be, but were made up by placing the small blocks inside the space defined by the circle in Fig. 2 and the trapezium showing single chair in Fig. 3. The difference between the right and the wrong

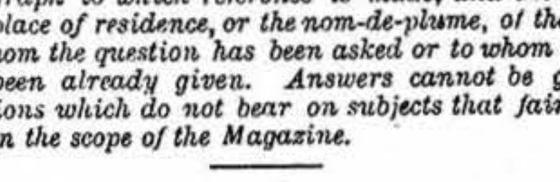

Fig. 2.—Mode of fixing Castors on Round Table.

method in putting on "Ideal" Patent Castors will be noted on comparing the illustrations in p. 410, which are wrong, with those given here, which are right. With regard to fixing castors on a round table, it is essential that the axes of the castor should, as I said, "point to a vertical line dropped from the

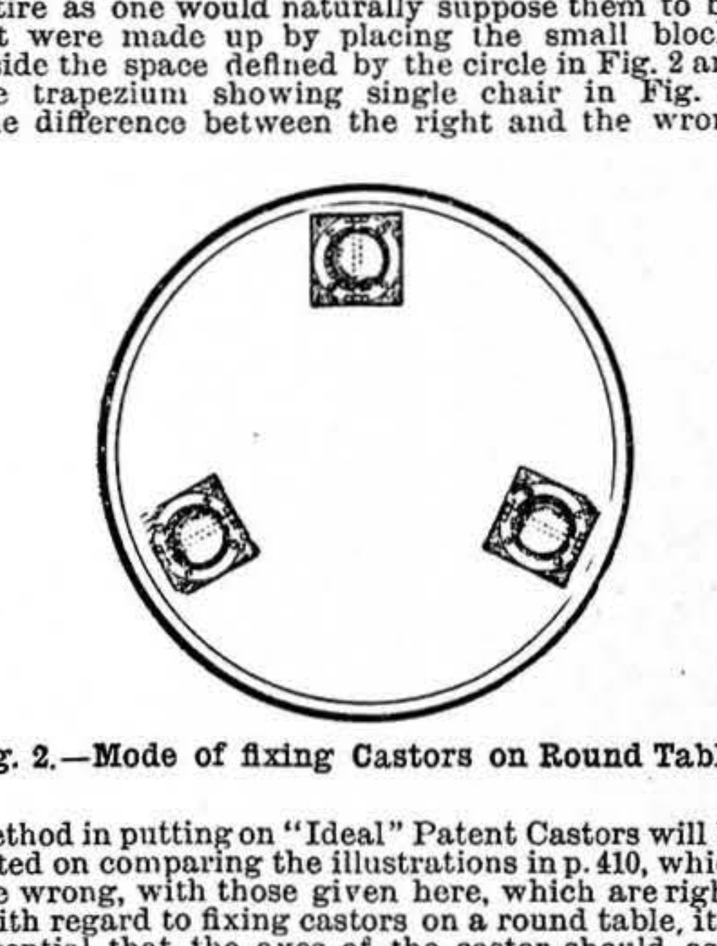

Fig. 3.—Mode of fixing Castors on Single Chairs.

centre of the table." In Fig. 3 "the axes of the front castors are parallel to the edge of the front of the chair, and the axes of those behind are at an angle of 45°, or thereabouts, with it." For the proper way under all circumstances, and for various kinds of furniture, recourse must be had to Mr. Copus's prospectus and price list.—ED.

Lamp Explosions.—H. G. N. (*Islington*) writes:—"I observe in notes as to wants in Inventors' columns in WORK that hitherto there has been no safety paraffin lamp invented. I am inclined to think that if lamps were made in the same way as the paraffin stoves—that is, with an extra stopper with a small hole in it for the gas generated by heat to escape—there would be no explosions, for I have never heard of a stove exploding. I have pointed this out to several lamp makers, but no one has adopted it yet, and I have too many irons in the fire to patent the idea myself."

Cricket Bat.—W. S. (*Northampton*) writes:—"Will you please put this in WORK? as I think it very important that a misleading answer to any person or subject should, if possible, be put right. The answer about which I am writing appeared in p. 75 of the present volume, under the heading of 'Cricket Bat.'—NO NAME. J. W. H. says: 'Celebrated makers use pieces of whalebone halfway up the handle, and one-third down the bat.' Let me say that whalebone is not finished off halfway up the handle, but goes right through the same. Again, he says: 'Some make handles of lancewood and some of willow.' Has he lost faith in cane, or is it too much trouble to make it up into handles? He may introduce any article he likes into handles; but there is nothing yet to stand the wear and tear as cane. It holds into the splice better, and is so much lighter and stronger, and has more spring in it than anything, and resists, if made right, the jarring more than anything yet introduced. When makers line up handles with willow or ash, or any other wood, it is simply to reduce cost of material. Now with respect to the splice. Has J. W. H. ever made a spliced handle bat? I say no; and unless he knows what he is talking about, I think it would have been best to have left it alone; and if he has got an idea of his own, he can tell it to the nation, but do tell the questioner right. Now, the splice of a bat is not made as J. W. H. says, as a V-joint, but simply as a wedge, cut and fitted properly. I will defy him or anyone else to make a job of a handle splice made in the manner he has shown. He may make a clear joint back and front, and he may allow the glue to fill up the rest of the joints in the V. It is no good, again, as it has more tendency in it to split the blade than the plain wedge. Again, he says: 'The inquirer does not like pins or dowels;' but he strongly recommends them. *Let him!* It clearly proves he has no faith in his recommended splice. The inquirer is right; do not pin on any account. It is useless; and if made right, does not require anything but good joints and glue. If the querist cares to ask me how to make a cricket bat, if he will send me a stamped address, I will with pleasure tell him, as plainly as it is possible to do so, and tell him right."—[Any instructions you may wish to give must be given through the medium of "Shop," and not by private correspondence.—ED.]

Testing Accuracy of Framework.—J. S. (*London, N.*) writes:—"I must protest against J. C. K. in his comments, page 427, terming as an 'erroneous plan' the method of testing the accuracy of framework which I and another contributor gave in different numbers. I should not have sent the hint had I not passed by the one previously given. I thought, however, that it might be useful to those who do not possess squares, compasses, etc., and not particularly for wood-workers. J. C. K. is, of course, right in his other remarks—at least, I cannot answer for the Egyptians, as I never knew them: intelligent, it seems, although no WORK existed. J. C. K. supposes one side of his 'square' to be 5 in., and the remainder individually $4\frac{7}{16}$ in. long. Now, the amateur or professional workman who would cut four rails, each of which should be $4\frac{7}{16}$ in., and yet cut one much longer, is yet to be found. I will not believe such a flagrant error possible. But where four rails are *exactly* equal, or where a frame contains one pair of one length and another pair somewhat shorter, it is, by a long way, no impossibility that those rails *may* be mitred up apparently correct, and yet be out of the square. Naturally, I supposed it would be fully understood that outside measurements would be taken in addition to diagonal ones; which outside measurements, although proving the correct length and width of a job, would *not* prove its right angularity. It seems that if I do not stick to originality and designing, I shall get into hot water; but, happily, I have crawled out this time."

II.—Questions Answered by Editor and Staff.

Softening and Mounting Tiger Skin.—TIGER.—Without being able to see what the present state of the skin may be, it is hard to give exact directions as to your method of procedure. If it has only been roughly taken off and cured, I should say damp it by rolling in damp cloths; stretch it tightly, hair downwards, carefully remove any lumps of fat, flesh, etc., with a knife, and then rub it down with pumice-stone and powdered chalk. The chalk takes out the dirt, grease, etc. A skin may be softened by rubbing only. The softness so much admired in certain skins brought from South Africa is said to be produced solely by long and patient rubbing between the hands of native women. But such substances as yolk of egg, oil, etc., worked into the pores, assist in giving pliancy. The kid skins of which gloves are made is softened with yolk of egg, and then rubbed backwards and forwards over the edge of a blunt semi-circular knife. As regards mounting, no lady who is clever with scissors and needle need find much difficulty. A thin crimson cloth, cut in scollops with the scissors, is generally used to surround the skin. For lining, a less showy material suffices.—M. M.

Electrotyping.—G. D. (*Lewisham*).—Assuming that the work to be copied is small, you will find the single cell process the most suitable for your purpose. Into a glass or earthenware vessel of about a gallon capacity place a white, close-grained porous cell, of about 3 in. diameter, and just a trifle taller than the outer stoneware jar. Next place an amalgamated zinc rod or cylinder, with a binding screw attached, in the inner porous cell, and then charge the latter with water, slightly acidulated with sulphuric acid. The zinc must not be allowed to touch the sides of the porous cell, but should be suspended in the solution by means of a couple of pieces of copper wire passed through holes drilled crosswise at the top of the zinc. For the outer cell make a saturated solution of sulphate of copper, by dissolving the pure crystals in warm water until it refuses to dissolve any more, and as soon as it has become cool pour the solution into the outer cell and add ½ oz. of sulphuric acid to each quart of liquid. A piece of perforated copper, cut to a suitable form, should now be suspended at the upper part of the outer cell, on which to support fresh crystals of sulphate of copper to compensate for the copper deposited on the mould, and thus keep the solution at a uniform strength. If preferred, a muslin bag filled with the crystals may be suspended in the solution for the same purpose. The plaster mould is now attached to the end of a piece of stout copper wire by twisting the latter securely round it, after which the entire surface to be copied is carefully and thoroughly covered with the best plumbago (blacklead). Thus prepared, the free end of the conducting wire is bent at right angles in the form of an L, and the short end is inserted in the hole in the binding screw of the zinc, with the other end of the wire to which the mould is attached dipping into the copper solution with its face *towards* the porous cell. A bright red deposit of copper will soon appear on the end of the conducting wire, from which it gradually spreads over the entire surface of the mould. If the copper deposited on the mould appears to be dark, the latter should be moved further away from the porous cell, as it is a sure indication of the current being too strong. When the current is weak it gives a pale or crystalline deposit, which should be corrected by bringing the mould nearer to the porous cell, or by the addition of a few drops more sulphuric acid in the inner cell. Whenever it becomes needful to alter the position of the wire attached to the mould, it is important to always screw up the nut of the binding screw tight again. In an ordinary way an electrotype sufficiently stout for all general purposes can be obtained in about twenty-four hours; but the action can be continued much longer if desired. Care should be taken not to remove the mould too soon, otherwise the electrotype may be accidentally damaged. If both sides of the mould have to be deposited upon, it will be requisite to occasionally turn the mould in order to secure a uniform deposit, as the copper always forms the thickest at those parts of the mould which are nearest to the porous cell. The mould can generally be separated from the electrotype by plunging them in hot water for a few minutes, after which the metal is trimmed up, polished, or lacquered, according to taste. Should any difficulty occur, write again as fully as possible. By looking up the Indexes you will find that several answers have already appeared in "Shop." You might, with advantage, read the articles which appeared in *Amateur Work*, Nos. 72, 73, 74, and 76, published at 6d. each by Messrs. Ward, Lock, and Co., Salisbury Square, E.C. Coin enamelling is too difficult a branch of work for an amateur to attempt with any hope of success, as the coins require to be undercut, then floated with the enamel, and afterwards fired and polished, the colour and beauty of the designs being mainly dependent upon the manner in which the engraving is executed. There are very few really good enamellers in the trade.—C. A. P.

Geometry: Honours.—J. W. C. (*Tavistock*).—Good books to use in reading for honours are: "Euclid," Hall & Knight; "Conic Sections," Smith. Write to Cassell & Co. for their catalogue of school works.

Lamp.—J. T. (*Biggleswade*).—I am not aware of a lamp being in the market for boiling water which burns benzoline. There is one which is used by plumbers, which forms a blowpipe lamp, using benzoline; but an ordinary methylated spirit lamp would be much more suitable, and three tablespoonfuls would certainly suffice to boil a pint of water in three minutes.—C. M. W.

Aquarium. — G. A. G. — As your aquarium measures 18 in. by 9 in., and is, I presume, of a proportionate depth, it is too small to admit of an effective self-acting fountain being inserted in it. You should have provided for the fountain before making the aquarium. You can, however, get over the difficulty by making a stand for the aquarium upon the lines of a fountain fully described in No. 69 of WORK, and connecting the jet-pipe, screw-plug, and the main pipe to the inside of your aquarium at similar points to those which they occupy in the diagram, covering them with rock-work. The only difference in practice will be that your aquarium will form the top basin instead of the open one shown in the diagram. Make the tanks to any dimensions you like.—C. M. W.

Fountain.—FOUNTAIN.—Your sketch of fountain has not reached me. You say that you made a fountain, but failed to make it play more than three-quarters of an hour. I should consider that a very fair time. Should you desire to make it play longer, you have only to make the vessels larger. With reference to furnishing you with a design for a combination fountain and fern-case, I shall be happy to do so upon learning some particulars as to size, material, and the position it is intended to occupy; also whether a plain or an elaborate design is wanted.—C. M. W.

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Saw Blade.—CYMRO could get a piece of band saw from the following agents and makers, which would suit his purpose by punching a hole in each end: C. D. Monninger, 10 and 11, Ray Street, London, E.C.; Messrs. Eadon, President Works, Sheffield; Messrs. Aublet, 35, Curtain Road, London, E.C.; or from almost any saw-maker. The price of saw, ¾ in. wide, would be 2½d. per foot; ½ in., 3d. per foot. You do not state the kind of handles you want to fasten. I should say to fasten with a good rivet would be the proper way to fasten them firmly.—A. R.

"Work" Exhibition.—R. O. (*Elgin*).—No "Work" Exhibition will be held for 1891-92.

Standing Hammock.—F. H. B. (*Forest Gate*).—What do you mean by a "standing hammock?" Hammocks are always slung, and must be so from their construction. There is an article entitled "How to Net a Garden Hammock" in Vol. II., p. 425, otherwise No. 79. It is impossible to answer any question in the number that appears in the week following its reception.

Flower Stand.—F. H. B. (*Forest Gate*).—Buy the Indexes to Vols. I. and II. of WORK, and you will then, by searching them, be aware of all that has been done in this direction, and be able to indicate to the publishers what articles you require. The Indexes may be obtained through any bookseller or newsagent, and the cost no more than 1d. each.

Carpenter's Shop.—F. H. B. (*Forest Gate*).—Your application is devoid of any particulars that would enable anyone to answer it. How could anyone tell you "how to fit up a carpenter's place, where to put the tools and shelves, etc.," when all the information you vouchsafe with regard to the place is: "The shop is oblong shape—I mean the place I work in." Send a plan, with dimensions, etc., and showing where the door and windows are. Writers can no more give practical directions that would be of any real value to you than the Israelites could make bricks in Egypt without straw.

Cost of Patents.—YOUNG CHIPS.—Under the provisions of the New Patent Act of 1883, the Government fees or stamps on applying for the grant of a Patent for an invention is a stamp impressed—of £1—on the application form, in reply to which, if accepted, the provisional protection is granted, which lasts nine months, at or before the end of which term a complete specification, drawings, etc., must be filed, and this specification has to bear *three* impressed stamps of £1 each; and when the documents are accepted, the Patent issues. These stamps, however, have nothing to do with the cost of preparing the documents, drawings, etc., required by the law prior to the grant of the Patent, which will vary according to the amount of work required to be done, and the skill, ability, and experience employed in the performance. This kind of work cannot be successfully carried out by ignorant and inexperienced inventors, unaided by proper skill and knowledge of Patent matters, and it is owing to the persistent attempts of such people in preparing and putting in their own documents that the Patent Office records are being filled with invalid and useless Patents, hundreds having been patented long before, and others most hopeless and useless crudities; which is causing Patents to be regarded with suspicion and contempt, and doing an injury to Patent property which it will take years to put right. If a thing is worth doing at all, it is surely worth doing well.—C. E.

Patenting.—S. F. D. (*Lewisham*).—There is nothing to prevent an inventor preparing and putting in his own documents and making application himself personally for the grant of a Patent, if he pleases to do so. Before, however, he attempts to do this, he should ask himself if he understands what a Patent is, what it is required to comprise, and what he knows about Patent Law and the judicial requirements for a sound and valid Patent. If he arrive at the conclusion that he does not know, and has had no experience in such matters—as in ninety-nine cases out of a hundred it will be found is the case—it seems to us that he should decide that it would be a very foolish proceeding on his part to attempt to meddle with matters of which he possesses no knowledge or experience, and that, therefore, he should at once place himself in the hands of a respectable, skilled, and experienced person, capable of carrying out his wishes in a proper manner, or he will quickly find he is adding another useless and invalid Patent to the already existing mass of such as are on record. Unless one knows exactly what work has to be done in preparing the documents, drawings, etc., for his invention, and ascertaining the novelty of it, it is impossible to name an exact price for the cost, the work and requirements varying so much in each case.—C. E.

Leaking Cocks.—W. S. (*Ilford*).—Our correspondent does not tell us what kind of packed cocks he has to do with—whether shell-packed, plug-packed, or screw-down washer; but, according to his statement, they have begun to leak very soon. If I knew what kind, or whose Patent, they are, I might be able to give him the required information.—C. E.

Ploughs.—H. U. (*Ballycanew*).—These can be bought in several places, but Mr. McKinnon, Carrick Street, Glasgow, has long been known for producing excellent articles at a reasonable price. I would advise you to write to him. George Royle, Lovell's Court, Paternoster Row, London, also supplies them.—G. C.

Telephone.—T. R. M. (*Liverpool*).—The information you ask for is too much for "Shop" columns. It has already been given piecemeal through various numbers. Look up the Indexes, which you should have by you. Judging from the number of letters I have had from you, you are a constant subscriber, or, at least, should be. We never answer by post; so you must wait if you want information through "Shop," as others are content to do.—W. D.

Selling a Patent.—W. J. (*Heaton, Newcastle-on-Tyne*).—An invention for which provisional protection only has been obtained is *not* a Patent, and cannot be sold as such, there being no property to sell until the Patent is sealed. A man may sell his invention under these circumstances, covenanting to complete and assign the Patent when granted, if he can get parties to agree to such an arrangement. We have often carried out business of this kind; but, as a rule, it is not generally done, nor is it advisable to make such arrangements. It may, in some cases, be both advisable and advantageous to both parties to do so, but this will depend on circumstances. By law, a Patent is only granted to the true and first inventor; therefore, in strict law, any person whose name is added to that of the inventor, but who has not invented anything in the matter, will at once invalidate the Patent! What is the object to be gained by doing what our correspondent seems to wish, judging from the nature of his query? The proper thing to be done in the case is for the real inventor to apply in his own name for the grant of a Patent for his invention, and when obtained, he can then sell and assign his rights as he seems to desire, or make any other suitable or desired arrangement, there being then a property to be dealt with.—C. E.

Bookbinding.—AMATEUR.—I am pleased that you have been able to bind books from the instructions given in WORK. I am astonished that you want to know what a press-pin is, particularly so, seeing that you say you have a press, etc. A press-pin is simply an iron rod about the length of an ordinary kitchen poker, for putting into the holes at the ends of the screws, and is used as a lever for tightening up the press. A description of the process of making one is superfluous. If you have not one, you could use the poker with advantage. Pressing boards are smooth wooden boards for putting between books while in the press. Backing boards are long, narrow strips of hard wood with the top edge bevelled, and are put along the back of the book during the operation of backing. These things are fully explained in the articles on this subject. Rolls, fillets, and pallets are finishers' tools made of brass, with a pattern cut upon the face of them, and are used for the ornamental work. Read the articles over again, and you will get full particulars of all these. Your lathe and carpenters' tools will be of little use in the manufacture of these articles.—G. C.

Oil Paper.—C. B. P. (*Rockferry*).—You want to know how to make oiled "royal," "black carbonic," and "manifold" for duplicate order books, so that you will be able to manufacture them. In the first place, you will require elaborate machinery; and secondly, you would require to have a paper mill in full swing, as the first two papers are made from waste outsides and sheets with some flaw which would prevent them being sold as perfect ones. The tissue is prepared during manufacture; so you would have to set up a paper-maker's plant for this alone. I cannot give instructions for setting up a paper-maker's plant—at least, in this column. I know something about this class of machinery, and if you are really going in for it, I could advise; but if I was doing it here it would be somewhat of a free advertisement, which I would rather avoid.—G. C.

Electric Bell Magnet.—T. B. (*Liverpool*).—The number of layers of wire to be laid on the bobbins of an electric bell magnet are determined by the battery power to be used in ringing the bell. If a low-tension current of full volume is to be used, a few layers—say two or three—of coarse wire will be required. If a high-tension current of thin volume is to be employed, the bobbins must be wound with several layers of fine wire. In No. 12, Vol. I., of WORK, on p. 180, you will find a full table of the proportionate parts of electric bell magnets. For a 3 in. bell, the bobbins should be 2 in. in length by ¾ in. in diameter, and filled with No. 24 silk-covered copper wire. For a 4 in. bell, the bobbins should be 2½ in. by 1⅛ in., and filled with No. 22 wire. For a 6 in. bell, the bobbins should be 3½ in. by 1¼ in., and filled with either No. 22, 18, or 16 wire, just as may be required to balance the battery power. A greater number of turns or layers will ensure a stronger magnetic pull and a stronger stroke, if the tension of the current is high enough to overcome the extra resistance of the additional turns. A bobbin will take more layers of a fine than of a coarse wire, and the resistance will also be higher.—G. E. B.

Leyden Jar.—T. F. (*London, W.*).—Get a wide-mouthed glass jar holding from one to two pints, or a confectionery glass jar. Also get some good tinfoil and some thin varnish. Rinse the jar with some thin varnish, then coat it with tinfoil to within about 1 in. of the top. Coat the outside in a similar manner. Get a disc of hard wood (such as mahogany) to fit the mouth of the jar, and have it smoothly polished and varnished. In the centre of this disc fix a brass rod 4 in. in length, with a hook turned on the inside end, and a round brass knob on the outside end. Hang a piece of brass chain to the hook inside, and let the chain be long enough to just touch the bottom of the jar. The brass rod may go to the bottom of the jar and terminate in a disc of wood coated with tinfoil, instead of having a length of brass chain, if so desired. The upper part of the rod above the cover may be curved, but must terminate in a metal ball. To charge the jar from a Rhumkorff coil, place the jar on a thick piece of glass, on which has been placed a sheet of tinfoil. Connect the tinfoil with one terminal of the secoudary wire, and connect the knob of the jar to the discharger. Work the coil in the usual manner, passing sparks between the points of the discharger; but do not allow these to touch each other.—G. E. B.

Electric Engine.—J. M. (*Liverpool*).—Electric engines made in imitation of steam engines rarely work in a satisfactory manner. If you wish to work your model lift with a small engine made in imitation of a steam engine, but driven by electricity, do so in the following manner: Make or get a model steam engine. Also make or get a small electro-motor, and conceal it under or at the back of your model lift. From the motor convey a fine gut band to the driving-shaft of the engine, and work the engine with this. A model electro-motor suitable to this purpose was described in No. 109, p. 71, Vol. III., of WORK. The motor may be made to work the driving gear of your lift direct, if you do not wish to show the engine. The battery of three or four pint bichromate cells may be at some distance from the motor, the current being conveyed by No. 18 wire. The speed will be high, but you can pull this down by suitably reducing pulleys or wheels. The motor will pull the lift up, but it will fall by its own weight when the current is switched off, so should be provided with a brake to ease the descent.—G. E. B.

Dry Battery.—W. C. H. (*Godalming*).—The makers of dry batteries either patent them, and thus protect themselves against imitation, or keep the process and proportions a dead secret. On p. 97, Vol. II., of WORK, in reply to G. A. B. (*Ascot*), I have given instructions on making a dry battery; and in several other parts of Vols. I. and II. you will find information respecting the Gassner dry battery. This is all I can tell you about them. I cannot give you the "exact quantities of materials" used in dry batteries.—G. E. B.

Materials for Coils.—EXPECTANT.—Ebonite, platinum, and other material used in the construction of coils, can be obtained from any dealer in electrical instruments. Among those known to me are Messrs. King, Mendham & Co., Narrow Wine Street, Bristol; Mr. Bottone, Wallington, Surrey; Mr. G. Bowron, 93, Praed Street, London, W.; Messrs. Bonney & Co., 19, Avenue Road, Lewisham; and Messrs. F. C. Allsop & Co., 165, Queen Victoria Street, London, E.C. Sheet ebonite for coil ends and discs costs about 5s. a pound; platinum varies very much in price from week to week. By writing to one of the dealers mentioned above, you can always get a current quotation. If you want any odds and ends for coils, I should advise you to pay a visit to the electrical museum and second-hand emporium of Mr. A. Caplatzi, 3, Chenies Street, Tottenham Court Road. He has a great variety of coils and oddments of coils for sale or exchange.—G. E. B.

Silver-plating Tricycle.—B. B. (*Bradford*).—The simple silvering pastes you inquire about are useless for silver-plating the bright parts of a tricycle. Nitrate of silver will not deposit its metal by contact with bright steel, nor by simply immersing the steel in a nitrate of silver solution. All pastes containing silver are useless for plating steel. They can only be used in whitening bright and freshly cleaned surfaces of copper and of brass. To silver-plate bright steel, it must be first coated with copper or with brass in an alkaline coppering or brassing solution, and then silvered in a solution of double cyanide of silver and potassium. As these processes will involve the use of costly appliances and solutions, I should advise you to send your tricycle to a professional plater, or to the maker of the machine, and get it plated. The plant needed to properly plate tricycles will cost about £150 at the lowest estimate.—G. E. B.

Battery for Electric Light.—H. G. (*London, N.W.*).—The Bunsen is, without doubt, the best battery for electric-lighting purposes. It is not generally liked, because it gives off nasty poisonous fumes of nitrous oxide whilst at work; hence it has to be placed in an outhouse, and the wires brought to the lamps. It gives a strong and almost constant current for a period of from six to eight hours, if properly set up and used. At the end of each run of from six to eight hours it must be taken to pieces and cleaned, and its parts must always be put away clean. Get Nos. 1, 2, and 3 of WORK (obtainable from Messrs. Cassell & Co.), and read the articles therein published about the Bunsen battery. They will tell you all about this battery, and how to amalgamate the zincs. Your four cells must be connected in series—that is, in tandem: zinc of one cell to carbon of next cell, and so on, a wire from a zinc at one end, and another wire from the carbon at the other end of the battery forming the line wires to the lamp. The four cells, thus connected, will furnish enough current to light up a 6 volt 5 candle-power lamp. The battery might light two such lamps if the lamps were placed side by side.

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If the lamp or lamps do not light when connected to the battery, the voltage of the lamp is too high, and more cells are required to overcome its resistance.—G. E. B.

Small Horizontal Engine.—C. F. (*Eastbourne*).—You ask advice as to making a small horizontal engine, and that is exactly what I am trying to give in WORK; I suppose, therefore, you have only just begun to take it in. Get Nos. 106, 110, 121, 125, and 131; the articles are also continued in the present number. You will see in No. 121 the size of the fly-wheel. The castings for this engine will shortly be advertised. You can buy second-hand engines by advertisement in the *Exchange and Mart*, or the *English Mechanic*, or at Caplatzi's, Chenies Street, Tottenham Court Road, London. The boiler may be 2 ft. 6 in. high and 1 ft. 3 in. diameter, and have a cross tube in the furnace. This will be a one-horse boiler.—F. A. M.

Copal Varnish.—F. T. (*Liverpool*).—To make copal varnish appears to be the height of many an amateur painter's ambition, judging by the queries for ingredients received. We have repeatedly stated that the novice has not the faintest chance of making it successfully. F. T. wants to know the *probable* cost of making a gallon. Here are a few items: the value of several domestic pots and pans, of the loss of his peace of mind, his wife's respect and patience, a quantity of good oil, turpentine, copal gum, etc., and perhaps the cost of putting out a fire right up the kitchen flue! Varnish is made according to the purpose it is intended to be used for. Prices range from 6s. to 36s. per gallon, and there is now so much competition amongst large manufacturers, that even were it a simple thing to undertake, copal varnish could not be made on the kitchen stove nearly so cheaply as it can be bought.—F. P.

Litho Transfer Paper.—W. G. (*Blackburn*).—Transfer paper is so commonly used now, and is so easily obtainable from any dealer in lithographic materials, that it is seldom, if ever, necessary for anyone to make it for themselves. By the way that you word your question, I do not quite understand whether you want a receipt for making the paper itself, or whether you wish to know the mode of proceeding to work in transferring from stone to stone, or from plate to stone, as the same paper may be used in either case; but I will give a couple of the most general receipts for making the transfer paper. Should the paper be required to be transferred to a warm stone, mix a size strong enough to be quite firm when cold, by boiling either parchment cuttings, glue, gelatine, or isinglass, etc. A good coating or medium to be used with this is either plaster of Paris, flake white, or chalk, etc., flake white being, perhaps, the best; this should be mixed smooth with water. Then warm the size, and pour the mixture into it, after which strain through a sieve or piece of muslin, but only experience will show how much white it is necessary to put to any certain quantity of size. A large flat camel's-hair brush should be used to put the coating on the paper, and any kind of paper may be used, such as ordinary drawing-paper, or very thin paper if the drawing to be transferred is very fine. Should the paper be required to be transferred to a cold stone, it is better to use starch in place of the size, and mix it with glue. The more adhesive the paper is required to be, the more common should be the kind of glue used. There are excellent papers for transferring good chalk work; but as these are more expensive, they are not so generally used as the following. The ordinary Scotch re-transfer paper is so well known that the receipt hardly bears repeating; but as every day brings fresh workers to the field of lithography, someone may be benefited if I herewith give it. It is simply made by mixing plaster of Paris and flour in equal proportions, by first mixing the plaster of Paris (which should be of the best) with water until it becomes a smooth liquid; this is obtained by continually adding a little water, and constantly stirring it, until it loses its natural propensity of settling into a hard substance. Then mix the flour with a little water, and boil it to a paste of ordinary consistency, after which add the paste to the plaster, well mix, and strain through a coarse muslin or fine sieve. Colour it by adding a little gamboge or vermilion, etc., which, when applied to the paper, enables the artist to easily distinguish the right side from the wrong. This applies equally well to the above receipts, and any kind of transfers can be taken from this paper, either from stone to stone or from plate to stone. Should you wish to know how to proceed in *transferring* from plate to stone, I shall be pleased, with the Editor's permission, to answer this, or any other question relating to artistic lithography, in "Shop."—A. J. A.

Reverse Transferring for Lithography.—T. A. J.—There are several methods of reverse transferring—to change the black letters of type, etc., to white ones on a black ground—one of which is to protect the drawing on the stone, or, in this case, the lettering, with resin, and etch it until the letters are raised from the level of the stone to a degree perceptible to the eye. Then wash the stone, first with turpentine to remove the ink, then with clean water, after which paint the stone solid all over with litho ink. When dry, it may be rolled up in the ordinary way in printing ink. The letters being now raised, it is necessary to level them to the stone with snake-stone; and the stone can be easily gummed, rolled up, and printed, the letters standing out white on a black ground. Should any accident occur to the groundwork in using the snake-stone, it can be easily filled in and remedied with litho ink. To make the letters level requires a very nice, neat, and patient piece of work. Another method is to take an impression of the subject in a strong ink, and dust powdered gum-arabic over it, so that it becomes slightly sticky if held before a fire or allowed to remain in any damp place. This now being placed over a damp stone, the gummy surface—and, consequently, the design or lettering—will be transferred to the stone. This should now be allowed to dry, and then the stone covered all over with litho or any greasy ink, and if the stone is washed in the ordinary way the lettering will stand out white on the stone, as the gum will protect the stone from the ink wherever the design comes. These are only two out of several methods for reverse transferring without the artist's assistance, several others being equally good; but I have only given the above so as not to confuse you in starting. It would be a good plan for you to try both and see which you prefer, but in either case you must be particularly careful to see that the edges of the letters are clean and neat. Should you, however, find any difficulty in working, write again, and let me know where your trouble lies.—A. J. A.

Zinc Plates for Lithography.—LITHO.—Zinc plates may be purchased ready grained for the lithographer's use at any of the dealers in lithographic materials. But, presuming you have only bought the plain zinc, and wish to prepare it yourself, as your question seems to imply, you would proceed in the following manner: After the zinc has been well rolled at the dealer's, it must be cut into sizes suitable to the subject in hand, and care will have to be taken to see that it is level and of equal thickness all over. Should the plate be required to be constantly in use—that is, as soon as one subject is finished the plate is required to be regrained ready for another—it is advisable to choose one thicker than if the one subject is to be drawn and kept on the plate, to allow for the wear in preparation. The zinc never being quite free from oxide, dust, etc., when first bought, it is necessary that all such foreign substances should be scraped off with a sharp scraper, which should be used at an acute angle with the zinc, so as not to dig holes into it. The next process is to treat it like a litho stone by smoothing it with pumice-stone (*vide* p. 19, No. 106, Vol. III., of WORK). But where zinc differs from stone is, that *every kind* of work must be drawn on a grained surface, no matter how fine it may be. It is, therefore, necessary that the zinc should be grained; this gives it that dull, rough appearance that you mention and point out in your sample (No. 1). The zinc must be grained in exactly the same manner as stone, only using a zinc muller instead of a stone one. After the plate is finished and well rinsed with warm water, it should be dried quickly, to prevent the water corroding the zinc. The finest grain may be given to the plate for pen work, and, naturally, a coarser one will be required for chalk work. These are the general principles for preparing zinc plates for lithographic purposes; to enter more into detail would be to take up too much of the valuable space of "Shop." In specimen 2, the colour and surface are obtained by coating the zinc with a solution composed by grinding lithographic stone down to a fine powder, making it into a pulp with water, and then laying it on the zinc, which gives it a surface like stone, and which, it is needless to say, can be, therefore, either polished or grained, and may be used in the same manner as a litho stone. A firm in Leipzig hold the patent for this kind of plate with a litho stone coating. It would, therefore, be advisable to apply to them or their agents if you wish to obtain them.—A. J. A.

Graining.—J. T. R. B.—Vol. II. of WORK contains a complete and illustrated series of papers on the art of graining. Send for an Index, and then you will find particulars of each lesson. They form a thorough foundation for any learner, and are written for the instruction of those having no other means of getting lessons. Classes are held in graining at the Finsbury Technical College. The finest work on graining, with beautiful coloured reproductions of grained panels, is published by the proprietors of the *Journal of Decorative Art*, 15, St. Ann Street, Manchester.—LONDON DECORATOR.

Enamel.—CHARLES.—Why attempt to make enamel when so many reliable brands are on the market? A useful bright red can be made by dissolving sealing-wax in methylated spirit, but this is only fit for fancy goods not exposed to the weather. No ordinary mixture of pigment and varnish can be made to answer so well as Aspinall's, for instance. Let me advise you to get the back parts of WORK, and complete your volume. You will find it a great bargain.—F. P.

Painting.—E. H.—There is no work published dealing solely with the pricing and measurement of painters' and decorators' work; but any established builders' price-book contains a set of charges such as architects require. When you consider that wages vary as much as 25 per cent. between different parts of the country, and that the condition and required finish have more to do with the price of painting than the quantity alone, you will gather why such a book could not be compiled. *Mensuration* should be studied for learning *how* to take quantities.—LONDON DECORATOR.

Lime Wash.—G. M. G.—The cause of your liming turning yellow is probably due to the stained condition of the surface it is put upon, and which stains will strike through every coating. Try scraping off all the old coating with a wash of plaster of Paris and water, and then re-lime. Use chalk-lime; get it fresh from the kiln, and slack it when you intend to use it. A little blue or black colour helps to kill the yellow tint of the lime, but it will not affect the staining trouble.—F. P.

Plumbago.—H. P. (*Ash-next-Sandwich*).—Are you not aware that plumbago is the chemical name for blacklead—*oxide of carbon?* I fail to understand the purpose you require it for, and what you mean by small quantities. However, for 1 lb. I should say, go to the oilman: for 1 cwt., write to Farmiloe and Sons, Rochester Row, London, who will quote you for any such commodities according to your requirements.—F. P.

Waterproof Covers.—SCOT.—WORK, No. 73, page 340, contains a reply on "Waterproofing Canvas," which appears to be the receipt you want. If you have not that issue, send 1½d. to the publishers, and they will forward same at once.—F. P.

Oak Graining.—J. S. (*Birmingham*).—The only patterns for practice work that I can personally recommend to the student are those published with the Manchester work on graining. These are some of the best English chromo-lithography work that has been produced; and as the original panels were executed for the book by past-masters in the art, nothing finer can be desired. Write to 15, St. Ann Street, Manchester, and mention WORK. Inquire also, from the same source, as to panels of real woods for learners.—LONDON DECORATOR.

Paint and Distemper.—M. N. (*Rockhampton*) wants to know what will prevent the salts of cements coming through paint and distemper. You should not have painted the wall just after it had been made good, as it had no time to dry, and, as you may naturally expect, when you rub a wet article over a wet article the latter gets diluted with the former, as it has done in your case. The wall should have been left to dry for about a week at least, and then well sized before being painted. You ask me, in your letter, if I can give you a remedy for Portland cement. If you will repeat your question more clearly, and tell me what is wrong with your Portland cement, I will only be too pleased to try and answer your query.—W. B.

Exposure for Enlargements.—G. F. G. (*Oldham*).—Having made the enlarging camera, I take it for granted from your letter that you are familiar with the process of developing, and simply desire a few hints about the exposure necessary. This varies very much, according to the density of the negative, the time of day, the intensity of the light, and several other factors; and experience alone can guide you in the matter. I give you a few notes from a book in which I register particulars of all my exposures. They may serve to give you an idea as to how to proceed. January 6: thin negative, stop f 10, foggy day; exposure, 35 minutes; Eastman paper. February 10: ordinary negative, stop f 10, dull day; Eastman paper, 15 minutes. July 12: ordinary negative, stop f 20, bright day; 6 minutes. October 4: dense negative, stop f 20, sunny day; Ilford rapid paper, 2½ minutes. You will thus see that the necessary time varies considerably. A good plan is to proceed as follows: Take an ordinary negative, put it in the camera, cut a strip off your paper ½ in. wide, and place it in the dark slide; pull out the shutter one-fourth, expose five minutes, pull out another fourth, expose another five minutes, then again a fourth more for another five minutes. The strip will thus be exposed five, ten, fifteen, and twenty minutes in different parts; develop, and see which exposure is nearest perfect, then time your enlargement accordingly. Avoid letting the sun shine on your negative when enlarging. I generally choose a dull day, as I find the results, with long exposures, to be much more satisfactory. In the matter of papers tastes differ, but I think you will be quite satisfied with either Eastman's or Ilford rapid. I prefer the former, although a trifle dearer.—G. LE B.

Plush for Frames.—PLUSH FRAME.—An article on plush-covered frames is in the hands of the Editor, and if it has not appeared ere you see this, it will do so shortly.—D. D.

Cabinet Maker.—COUNTRY LAD.—I can quite appreciate your difficulty in acquiring practical experience in making good furniture. It is a most difficult matter to find a so-called cabinet-maker's shop in which the things are made for general sale. Wherever you go you will find that all the shops in which the furniture is sold to the public get the bulk of their goods from London, where it is made and supplied by wholesale dealers. The actual makers there seldom make more than one class of article, and though there are some shops in which really good things are made, they are comparatively few. If you could get into one of them, you might, by keeping your eyes open and working hard, learn a good deal; but undoubtedly your best plan would be to avoid the trade shops, and get into some retail house where things are actually made. Although, as I have said, most of the things are bought from outside makers, there are many retail cabinet makers who keep a few men for general work, and it is in such a shop that you will gain most experience. As such shops are found all over Great Britain, or, at any rate, in all the larger towns, such as London, Birmingham, Liverpool, and Manchester, you will see it is quite impossible to give you a list of firms who might be willing to engage you, even were I able, off-hand, to be able to sit down and write one. All you can do is to watch

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your opportunity and make inquiries from your fellow-workmen; but I do not think you stand much chance of getting such employment as you want where you now are. I do not know if you have joined either of the cabinet-makers' trades unions. If you are able to, you might find it to your advantage to do so, though I fear, from what you say of yourself, that you would hardly be eligible. I am not at all surprised to hear that you have found the articles in WORK to which you allude of use to you. You will find more practical information in its pages than in any other periodical.—D. D.

Plating Forks.—W. G. (*Harrogate*).—For the price paid (30s. per dozen) the best quality could not be expected. Have they been carefully treated and cleaned with fine polishing powder, such as washed whiting? or have they been left in vinegar, etc.? Coarse polishing materials will soon fetch plating off, and so will vinegar and sauces. It will be best for you to take them to some respectable silversmith or jeweller in your town, and ask him to get you an estimate for re-plating with silver, which should cost from 15s. upwards the dozen to do properly. As the metal itself is yellow, it might be well to get an estimate to nickel-plate them first, and silver-plate them afterwards; or perhaps nickel-plating alone would do, when the cost would be 7s. 6d. upwards for the dozen. Nickel has not the colour of silver, as you can see by looking at the plated parts of cycles. If you buy other plated goods and want the best, it should be that known as E.P.N.S., which can be translated, English plate nickel silver; but you will have to depend on your silversmith, anyhow, so choose a man of established reputation.—H. S. G.

Black Varnish for Pins.—J. W. (*Kensington*).—No special machinery is required for these, only a few cans with gauze bottoms, and a larger piece of gauze in a frame on which to spread the pins for draining and drying. The varnish used is what is generally called japan, and requires a stove heated at a temperature of from 250° to 300° Fah. These japans, of which asphaltum, gum amber, and boiled oil, form the chief ingredients, requiring from three to five hours' boiling, and a special knowledge and appliances to make satisfactory, are best bought ready made from the makers; in fact, large japanners seldom make their own. Should you, however, require the proper proportions and ingredients, and will write us again, we will gladly furnish them. As these japans are thinner when hot, it may be necessary to adopt some plan, such as a sand bath, to keep them hot when using; and as for the purpose you name a brush is useless, it will be seen that the better plan would be to put the pins in one of the gauze-bottom cans, place this over a water-tight one, and pour the japan through; drain well, and spread out on the gauze in the stove to dry. How much heat is really necessary, and how long an exposure is required, can only be acquired by actual experience. There are many makers of japans and varnishes in your neighbourhood to whom you might write, giving full particulars of your requirements: W. T. Bigsby, Trundley's Road, Deptford, London; R. P. Butteress & Co., Assembly Place, Mile End, E.; C. W. Schmidt, Carpenters' Road, Stratford, E.; Meredith and Co., 107 and 108, Lionel Street, Birmingham.—LIFEBOAT.

Anti-vibrator.—G. W. C.—The anti-vibrator described in WORK, page 407, Sept. 12th, No. 130, is not protected by any patent rights, and can be made and sold by anyone.—CYCLOPS.

Anti-vibrator.—CYCLIST will be able to get the castings for the anti-vibrator described in WORK, page 407, Sept. 12th, from H. Cliff, Old Foundry, Leeds Road, Bradford, by sending patterns of same; or he could, no doubt, get the anti-vibrator made complete by Mr. G. W. Carr, 83, Villiers Street, Dresden, Loughton, Staffs. The cost of malleable iron castings is something under 6d. per lb.—CYCLOPS.

Monogram.—E. R. (*Bermondsey*).—I am sorry to disappoint you, but monograms are costly to engrave, and the space they occupy cannot be spared. Those already given will furnish you with some idea of the method to be adopted in working out your own.

Exhibitions.—F. G. W. (*Kettering*).—There will be no "Work" Exhibition this year, and I am unable to tell you in what places local exhibitions are contemplated, as I am without information on the subject. Secretaries of local exhibitions should always send early notices to WORK, and then announcements of them could be made in these pages.

Power to Drive Machine.—IGNORANT.—If a machine takes 7 to 8 h.-p. when driven direct, when a line shaft is interposed between the two, there will be a very slight increase of power required, owing to the friction at the journals of this line shaft. The distance apart of the pulleys on the line shaft has nothing to do with it, except that, if they are far apart, there will have to be more bearings on the line shaft, and therefore more friction; also, if there was only *one* pulley on the shaft which both received and transmitted the power to the engine—the engine being on one side and the machine on the other—the belts would pull against each other and so relieve the journals of most of the friction. The friction will be very small if only the shaftings and journals are properly in line and firmly fixed.—F. A. M.

Positives on Dry Plates.—AMATEUR P.—Practically, it is not impossible to take such pictures on ordinary dry plates. The method used is the collodion wet plate process, either on glass or ferrotype plates, and the development by means of an acid solution of iron sulphate. Of course, positives may be made on Ilford plates as transparencies; but emulsion processes are unsuitable for the display of images by reflected light, which is a matter of necessity in the work alluded to.

Bookbinding.—H. W. (*Helston*).—Articles on bookbinding appeared in Nos. 6, 9, 57, 61, 65, 69, 72, 75, 80, and 85; and queries relative to the articles are answered in "Shop" in Nos. 14, 16, 17, 18, 32, 38, 45, 46, and 50.

Registration of Designs.—S. A. C.—It is possible that some papers on this subject, which may be useful to you, will shortly appear in WORK.

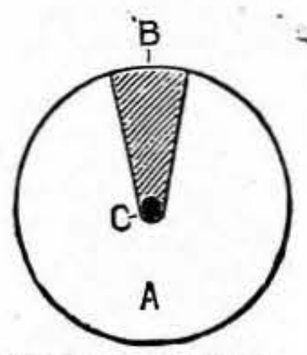
III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Fountain Driven by Engine.—C. A. P. (*Ealing*) asks:—"Can any reader give me any information how I could make a small fountain worked by a hot-air engine? I should like the fountain to throw a continuous jet of water about 18 in. high; the whole to stand on a base about a foot square."

Marionette.—C. A. P. (*Ealing*) writes:—"I should be glad if you could tell me how I could make a marionette, about 15 in. to 18 in. high, to dance like those at the Aquarium, on a miniature stage."

Linen Buttons.—W. L. (*Huyton*) asks:—"Will anyone kindly give me the names and addresses of the *best* linen button manufacturers?"

Grooving Cane.—A. W. W. (*Victoria Park*) writes:—"Can any reader inform me where I can procure a tool, and what kind of tool it is I require, to cut a groove in cane after the manner shown in section in the accompanying diagram, in order to place in the centre of the cane a piece of straight-drawn wire? The tool I require is one that will cut out the strip of cane to enable me to lay in the wire, and also replace that which I cut out."



Section of Cane—A, Cane; B, Piece to be cut out; C, Wire.

Drilling Grindstones.—T. A. D. (*Royton*) writes:—"I wish to ask if any reader of WORK can tell me what kind of system they have in those quarries where they make small grindstones, about 1 ft. in diameter and from ½ in. thick upwards, of drilling the holes in the centre? and if they are drilled on a machine or by hand? and whether they use ordinary drills or diamond-pointed drills? At the shop I work in they make a machine which is fitted with these stones in it to grind small moulding irons for joiners, and they have a square hole in them about 1 in. square, and we have to drill them out to 1½ in. round size. When we have drilled one hole in, it makes the drill too small for the next one. It takes all the edge off the drill where the stone touches the drill. We drill them on an ordinary drilling machine—a vertical one. We have had the drills hardened as hard as we could get them without breaking them. The stones come from the neighbourhood of Rotherham, in Yorkshire, and are of a soft nature. I should also like to ask if they are done with a machine, what kind it is, how it is worked, and by what means—whether steam, water, or hand—and what kind of drills?"

Plan of the Heavens.—M. D. C. (*Liverpool*) asks:—"Can any reader make a suggestion to utilise the plan of the Heavens given with the first part of 'The Story of the Heavens?' My idea is to have a stand with the plan in a frame with a swivel, to turn it round if required, and to take it off when not required."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Bath, to Heat.—J. H. (*Smethwick*) writes, in answer to ROUND O (see page 414, No. 130):—"If he could raise his bath high enough to get one of Truman's stoves in under it he could heat his water at any time or to any heat. He would have to raise it at each end 10½ in., the height of stove."

Mail-cart Handles.—C. M. (*King's Cross*) writes:—"In reply to query by ADIA (see page 414, No. 130) about mail-cart handles, he can get what he wants from Mr. H. Matthews, Baron Street, Pentonville, who keeps a stock of them already bent, or would bend them to pattern if a few pairs were wanted. Mr. H. Matthews can be recommended for bent timber of any kind."

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—H. B. P. (*London*); J. S. (*Longsight*); T. D. (*Liverpool*); H. E. (*South Norwood*); GRANT; W. F. (*Ascot*); CHATHAM; ENVELOPE; H. F. M. (*Ramsbury*); LITHO; H. H. (*Finsbury*); J. S. (*Hampstead*); F. H. (*Battersea*); T. J. S. (*Finsbury*); W. E. D. (*King's Lynn*); N. F. (*Gateshead*); W. C. (*Sharpness*); C. A. P. (*Finsbury Park*); J. O. (*Bradford*); SCARBORO'; ESOR; J. H. (*Bishophill*); E. A. P. (*Tullow*); F. F. (*Brixton*); F. R. (*Gosport*); W. F. (*Gateshead*); W. N. H. (*Bradford*); A. H. (*Rochdale*); STOURBRIDGE; L. S. L. (*Kirkcaldy*); WHITEFIELD; BARKIS; J. H. (*Smethwick*); W. R. (*Yeovil*); LEARNER; LUX IN TENEBRIS; P. R. (*Edinburgh*); F. B. (*Aldershot*); J. G. (*Edinburgh*); A. P. M. (*Notting Hill*); E. J. B. (*Dartmouth*); J. P. (*Belfast*); EUSTACE; R. (*Edinburgh*); J. W. (*Camberwell*); R. C. (*Glasgow*); MAINSAIL; W. H. (*London, S.W.*)

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